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THE INFLUENCE OF TRIM UPON RESISTANCE OF SHIPS.

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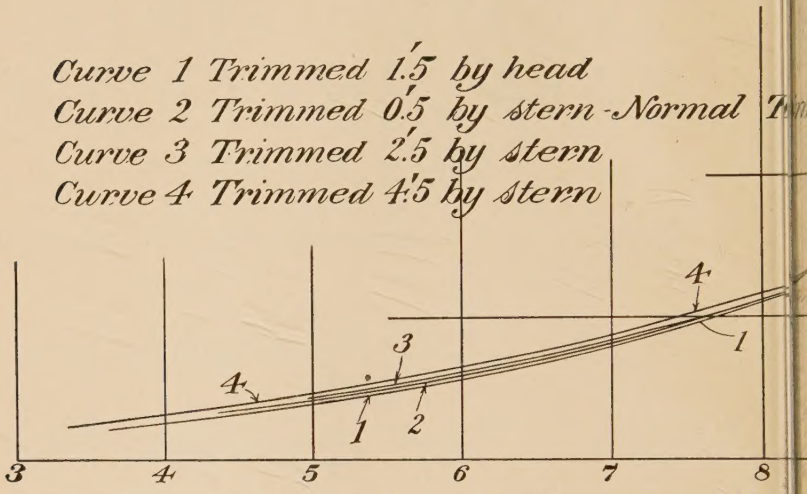
The question of the effect of trim upon the speed of vessels is one that has been much debated by those that go down to the sea in ships for hundreds—perhaps thousands—of years. It is altogether probable that Noah's sons thought that the old man kept the ark at a bad trim for speed. Certainly in the days of sailing ships the question of trim was regarded as a very live one, but change of trim for sailing vessels affects other qualities besides speed; for instance, maneuvering power. Naval architects of the present generation, however, regard moderate variations of trim as having little effect upon resistance for vessels of ordinary types and to them it will be somewhat surprising to find in No. 133 of the Proceedings of the Naval Institute (March, 1910) a paper entitled, "Wasted Horsepower and Economical Trim" in which there is an apparently serious attempt to demonstrate that a comparatively small variation from a supposed "Economical Trim" will result in "enormous loss of wasted horsepower."

As this article ignores well-known reasons which have influenced naval architects in reaching their present frame of mind as to the effect of trim, I propose to discuss briefly some of these reasons and then consider the arguments in the "Wasted Horsepower" article.

Curves of Resistance of the Greyhound at Normal Displacement of 1161 Tons and Various Trims

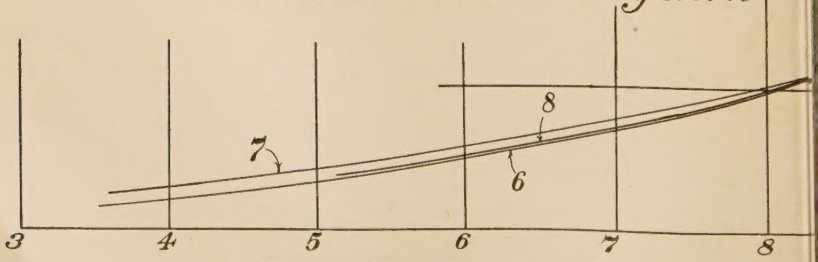
Curve 1 Trimmed 1.5 by head
Curve 2 Trimmed 0.5 by stern - Normal Trim
Curve 3 Trimmed 2.5 by stern
Curve 4 Trimmed 4.5 by stern



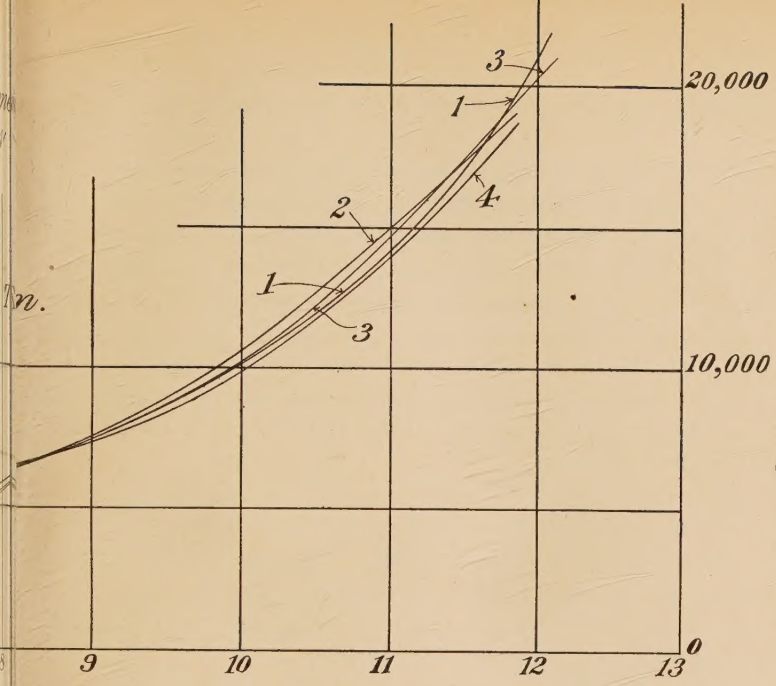
Scale for Speed – Knots per Hour

Curves of Resistance of the Greyhound at Light Displacement of 938 Tons and Various

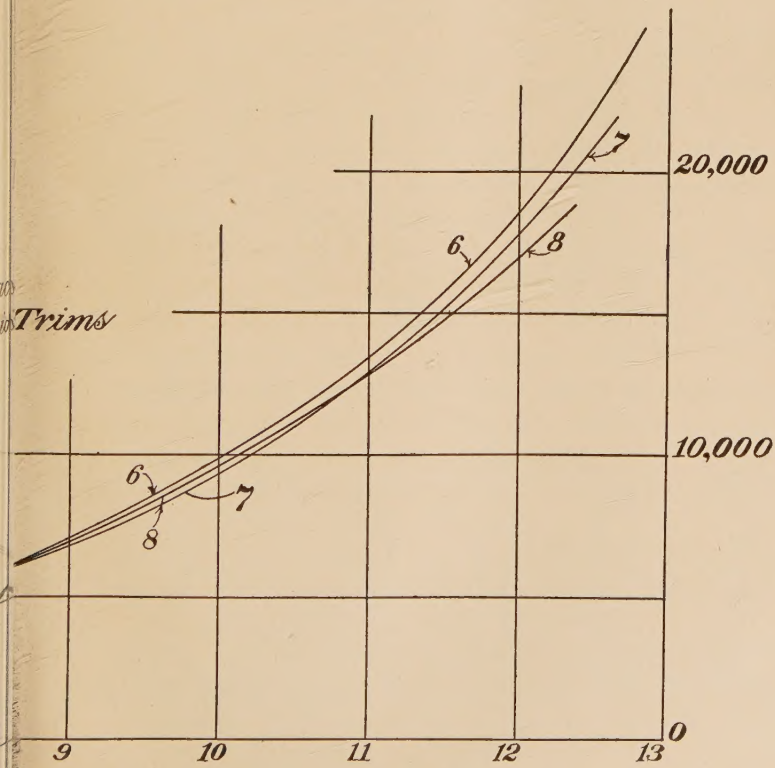
Curve 6 Trimmed 1.17 by head
Curve 7 Trimmed 0.5 by stern
Curve 8 Trimmed 4.5 by stern



Scale for Speed – Knots per Hour


3
1
20,000
2
4
1
3
10,000
Resistance in Lbs.
0
9
10
11
12
13

. I.


7
20,000
6
8
Trims
10,000
6
7
8
Resistance in Lbs.
0
9
10
11
12
13

There are two factors involved—namely, the resistance of the ship and the efficiency of propulsion, the latter being the ratio between the net horsepower which would be absorbed in towing the ship—called the effective horsepower—and the indicated horsepower. This ratio varies in practice from ship to ship roughly between the limits .5 and .6. It is affected by engine friction, propeller efficiency, wake factor and thrust deduction. The three last mentioned factors are liable to vary with variation of trim and hence the efficiency of propulsion is liable to vary with trim as well as the resistance.

Let us consider first the resistance. There is, of course, only one way to demonstrate with rigid accuracy the effect of change of trim of a full-sized ship upon its resistance. That is to tow the ship at various trims—all conditions except trim remaining unchanged—and determine curves of resistance at the various trims.

Such experiments were made by Mr. William Froude in 1871 when as one of an Admiralty committee he conducted the famous *Greyhound* experiments. The *Greyhound* was a vessel 172 feet 6 inches long between perpendiculars, of 33 feet 2 inches extreme breadth and 1161 tons normal displacement.

She was fitted with dynamometer gear and towed by H. M. S. *Active* from the end of a boom fitted to keep the *Greyhound* clear of the wake of the *Active*. For present purposes it is not necessary to consider the results of all the experiments which covered other questions than that of change of trim. Fig. 1 shows four experimental curves of resistance for the *Greyhound* at normal displacement and various trims, and Fig. 2 three curves for three other conditions when the displacement was light.

The trims and displacements for the various conditions are given below in Table I.

TABLE I.—DISPLACEMENT AND TRIM OF GREYHOUND IN VARIOUS TRIAL CONDITIONS,

Conditions.	Displacement. Tons.	Draught.			Trim.	
		Forward.	Aft.	Mean.	By Head.	By Stern.
1	1161	14′ 6″	13′ 0″	13′ 9″	1′ 6″	
2	1161	13′ 6″	14′ 0″	13′ 9″		0′ 6″
3	1161	12′ 6″	15′ 0″	13′ 9″		2′ 6″
4	1161	11′ 6″	16′ 0″	13′ 9″		4′ 6″
6	938	12′ 8″	11′ 6″	12′ 1″	1′ 2″	
7	938	11′ 10″	12′ 4″	12′ 1″		0′ 6″
8	938	9′ 10″	14′ 4″	12′ 1″		4′ 6″

In considering Figs. 1 and 2 two things should be borne in mind. In the first place the curves from the nature of the case cannot be exact. Froude himself says in this connection: "In proceeding to compare the results shown by the several curves of resistance, it must be observed that the minutiae of the features they present cannot be insisted upon as absolutely exact, because minor discrepancies in result were in some cases noticeable when an experiment was repeated with unchanged conditions."

In the second place the range of trim variation covered was relatively enormous. A range of 6 feet for a vessel 172 feet 6 inches long is, as regards angle, equivalent to a range of 15.65 feet for a 450-foot vessel such as the *Connecticut*.

While the maximum speed was only about 12 knots this speed of 12 knots for a vessel 172 feet 6 inches long corresponds to a little over 19 knots for a 450-foot vessel.

Considering Figs. 1 and 2 it is seen that for the *Greyhound*, broadly speaking, at low speeds trim by the stern was disadvantageous and at the upper speeds it was advantageous.

Froude's own conclusion in this connection is as follows: "As dependent on differences of trim, the resistance does not change largely; indeed, at speeds between 8 and 10 knots it scarcely changes appreciably even under the maximum differences of trim. In proportion as the ship is down by the head the resistance is, on the whole, increased at the higher speeds and diminished at the lower, and this character of difference is maintained at both 'normal' and 'light' displacements."

With the comparatively small changes of resistance of the *Greyhound* for such a large range of trim it would seem obvious that for this vessel the variation of resistance with the variation of trim possible in practice would be secondary.

Of course, it would not be safe to draw general conclusions from trials of a single vessel. But as a result of Froude's work it was generally accepted that the resistance of a full-sized vessel in any condition could be estimated with reasonable accuracy from results of trials of a model of the same.

As a matter of fact, it was in connection with his classical *Greyhound* experiments that the elder Froude first demonstrated the value and reliability of model experiments.

Now in a model basin it is a very simple matter to test the effect of change of trim upon resistance. The matter has been

investigated thus at the U. S. model basin during years past for models representing practically every modern vessel in the U. S. Navy and also for a large number of experimental models. In no single instance has there been found any great change of resistance for the usual range of trim variation—say 2 or 3 feet for a 450-foot vessel. The majority of the models of our earlier ships show slightly less resistance when trimmed a little by the stern than when upon an even keel but the difference is of no practical importance. With the forms that have been adopted for our later ships the variations of resistance of the models with changes of trim practicable for the ships are usually even smaller than for the older ships.

When the *Kansas* on trial showed such poor results trimmed two or three inches by the head a great many people jumped to the conclusion that it was because of the trim by the head. During the design of the class the effect of change of trim had been investigated as usual with the usual result that it was found to have no material effect. After the *Kansas* trial additional very careful experiments were made with a model of the *Connecticut* (the same as the *Kansas*). The differences were hardly large enough to measure with accuracy. Fig. 3 shows the E. H. P. curve for the vessel on an even keel and percentage variations of power for various trims as determined from model experiments. The effect of trim change is expressed in the figure by curves of percentage variation because it would be impossible to make a clear diagram of the size of the figure with curves of E. H. P. for each trim.

As shown in Fig. 3 the experiments indicate that the *Connecticut* class offer slightly more resistance when trimmed by the stern for speeds below 16 knots. Above 16 knots trim by the stern is slightly advantageous but the benefit is not as much as 1 per cent for practicable variations of trim.

So far, then, as the resistance is affected by change of trim it may be stated positively:

1. That in the case of the *Greyhound* where this specific question was carefully investigated by trials of a full-sized vessel the effect upon resistance of variations of trim such as are found in practice was of a minor nature.

2. That numerous experiments at the U. S. Model Basin extending over years have shown that so far as can be determined

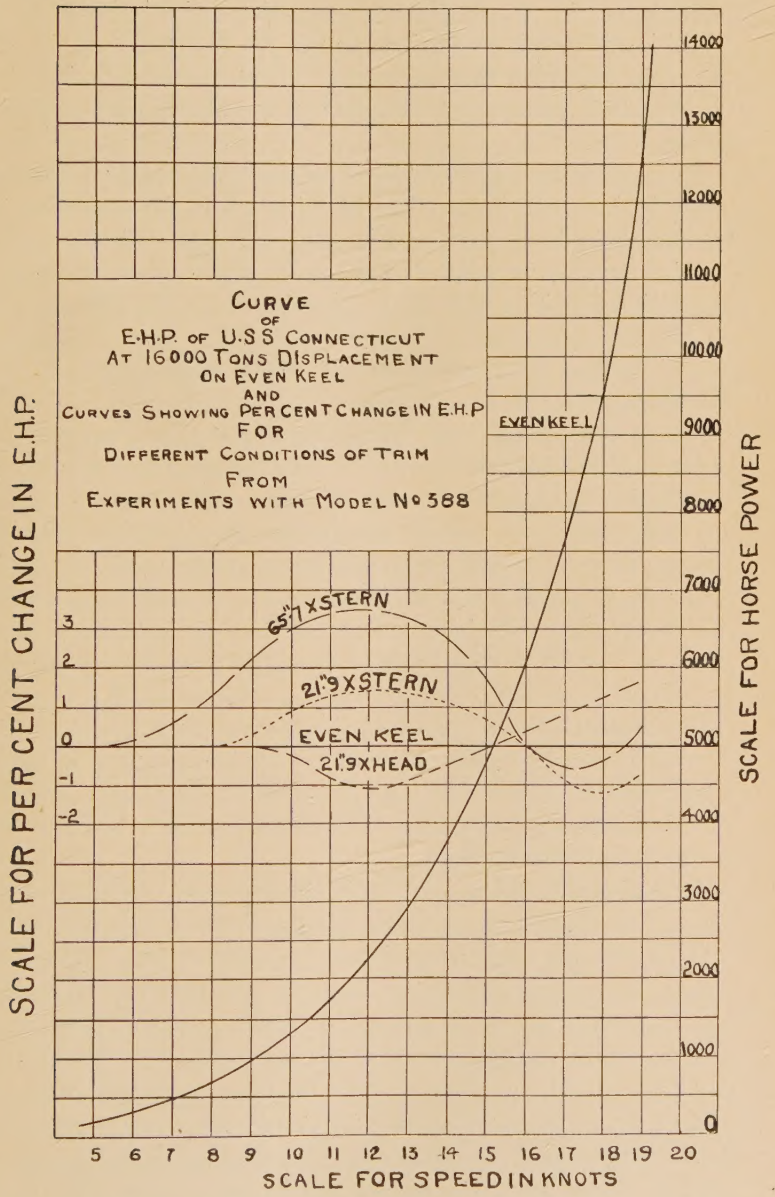

CURVE
OF
E.H.P. OF U.S.S CONNECTICUT
AT 16000 TONS DISPLACEMENT
ON EVEN KEEL
AND
CURVES SHOWING PER CENT CHANGE IN E.H.P
FOR
DIFFERENT CONDITIONS OF TRIM
FROM
EXPERIMENTS WITH MODEL No 388
EVEN KEEL
6.5"X STERN
21'9"X STERN
EVEN KEEL
21'9"X HEAD
SCALE FOR PER CENT CHANGE IN E.H.P.
SCALE FOR HORSE POWER
SCALE FOR SPEED IN KNOTS
3
2
1
0
-1
-2
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

FIG. 3.

from model experiment the effect upon resistance of vessels such as compose the U. S. Navy of variations of trim such as are found in practice is of a minor nature for all types.

It may be added that experience of other model basins along this line is in full accord with that of the Washington establishment.

The evidence brought forward in the "Wasted Horsepower" paper is, however, from trials of ships when self propelled, not from trials to determine resistance only. It is certain that change of trim may be expected to have *some* effect upon efficiency of propulsion but it is difficult to conceive from the nature of the phenomena concerned how the effect could be great. However, we are not now concerned with how things happen but with what does happen.

Before considering some of the results of trials quoted in the paper on "Wasted Horsepower" it may be remarked that the determination of accurate curves of speed and power on trial is not such a very easy matter. Indicators should be carefully calibrated and standardized, and handled by people skilled in taking diagrams, if power results which can be relied upon as practically correct are to be obtained. Hence it is never safe, from a few speed and power curves, to draw conclusions which depend upon the minute accuracy of the curves.

Furthermore, there are a large number of factors which affect the speed and power of a ship and it is obviously wrong to ascribe a variation in power for a given speed to one factor which is varied unless we know that the others are not varied or that the variation has no effect.

A good deal of space is given in the paper on "Wasted Horsepower" to results of six sets of trials of the *Kearsarge*, curves of I. H. P. and speed being given for five of them. These five curves upon examination are seen to fall into two groups—a lower group of three curves and an upper group of two curves. The five trials varied as regards displacement, time out of dock, and trim. It will be found that for the upper group the times out of dock are stated to be 16 weeks and 23 weeks respectively. For the lower group these times were one week, two weeks and six weeks. There are various abnormal features about some of the curves which render it doubtful if they are of a high order of accuracy, but assuming them to be substantially correct it is

impossible to draw reliable conclusions as to the effect of change of trim when ignoring the fact that some trials were made with the ship much longer out of dock than others and presumably more or less foul. However, passing this by let us examine the demonstration of "Wasted Horsepower" for the *Kearsarge*. We find on page 210:

When the *Kearsarge* is at her "Economical Trim"—between 20 and 28 inches by the stern—the following facts obtained from Plate VIII should be noted:

1. Fewer revolutions are required to maintain the same speed.
2. Consequently less horsepower is needed.
3. And therefore from 5 to 6 per cent less coal is burned than when trimmed 12 inches by the stern.

In preparing Plate VIII referred to above the results of three trials only were used, namely when the *Kearsarge* was 12″ by the stern, 20″ by the stern and 36″ by the stern. The first conclusion quoted above agrees with Plate VIII. The second conclusion "Consequently less horsepower is needed" cannot be derived from Plate VIII, which deals with revolutions, speed and trim only. No doubt this conclusion *ought* to be true but a reference to the original curves of speed and horsepower given in the paper shows that they are not in accord with this conclusion.

Thus referring to the original curves of speed and power we have for 12 knots speed:

Trim of Trial.	Revolutions.	I. H. P.
12″ by stern	78	3450
20″ by stern	74	3430
36″ by stern	77	4000

In the above I have used 74 revolutions for 12-knot speed 20″ by the stern as given in the paper in Plate I instead of 75.2 as given on page 210, the latter being evidently in error. None of the revolutions for the various speeds at 20″ trim, as given in Table IV, page 210, agree with the revolutions for the same speeds and same trim as given in Table II, p. 201, although since they refer to the same trial they should presumably be identical.

It is seen that at 12 knots speed in spite of the difference in revolutions there is a difference of but 6/10 of one per cent in horsepower between the 12″ trim and the 20″ trim. Most people would conclude that this would result in about 6/10 of one per cent of difference of coal consumption instead of the 5 to 6 per

cent deduced in the paper. At 13 knots, though the revolutions for the 20″ trim are still well below those for the 12″ trim, the power is actually greater. At 12 knots for the 36″ trim the revolutions are 1 less than for the 12″ trim but the power is some 16 per cent greater.

Evidently the dictum that fewer revolutions need less horsepower does not apply to the data of the *Kearsarge* trials put forward, and as a matter of fact it would seem that the only positive conclusion that can be drawn from the data given for the various *Kearsarge* trials is that some of it is materially in error. Hence it does not appear necessary to take up some errors of method in the deductions from the *Kearsarge* data in addition to those already pointed out.

Let us consider now the *Connecticut* class results from which there are drawn in the " Wasted Horsepower " article some very sweeping and positive conclusions.

The paper gives the powers for four vessels of the class for 18 knots on contractors trials—plotted on trim. In Table II below will be found these powers for all six vessels of the class; the powers given being the main engine I. H. P.:

TABLE II.—SHOWING DISPLACEMENT AND TRIM ON STANDARDIZATION TRIAL AND I. H. P. AT 18 KNOTS FOR CONNECTICUT AND VIRGINIA CLASSES.

Name of Ship.	I. H. P. at 18 Knots.	Trim.	Disp. in Tons.
Georgia	14,815	Even Keel	14,963
Nebraska	15,000	2″ by Stern	14,940
New Jersey	16,060	6¼″ by Stern	14,883
Rhode Island	14,450	Even Keel	14,940
Virginia	15,800	3″ by Stern	14,990
Connecticut	15,500	24″ by Stern	16,375
Kansas	18,890	2⅞″ by Head	16,065
Louisiana	15,720	15″ by Stern	16,000
Minnesota	14,980	31 9/16″ by Stern	16,016
New Hampshire	15,800	25¼″ by Stern	16,023
Vermont	16,460	8⅛″ by Stern	16,007

There will also be found in Table II the same data for the five vessels of the Virginia class. In Fig. 4 these horsepowers are shown plotted upon the trim. The spots for the *Minnesota, Louisiana, Vermont* and *Kansas* are joined by a curve as in Plate 9 of the " Wasted Horsepower " article.

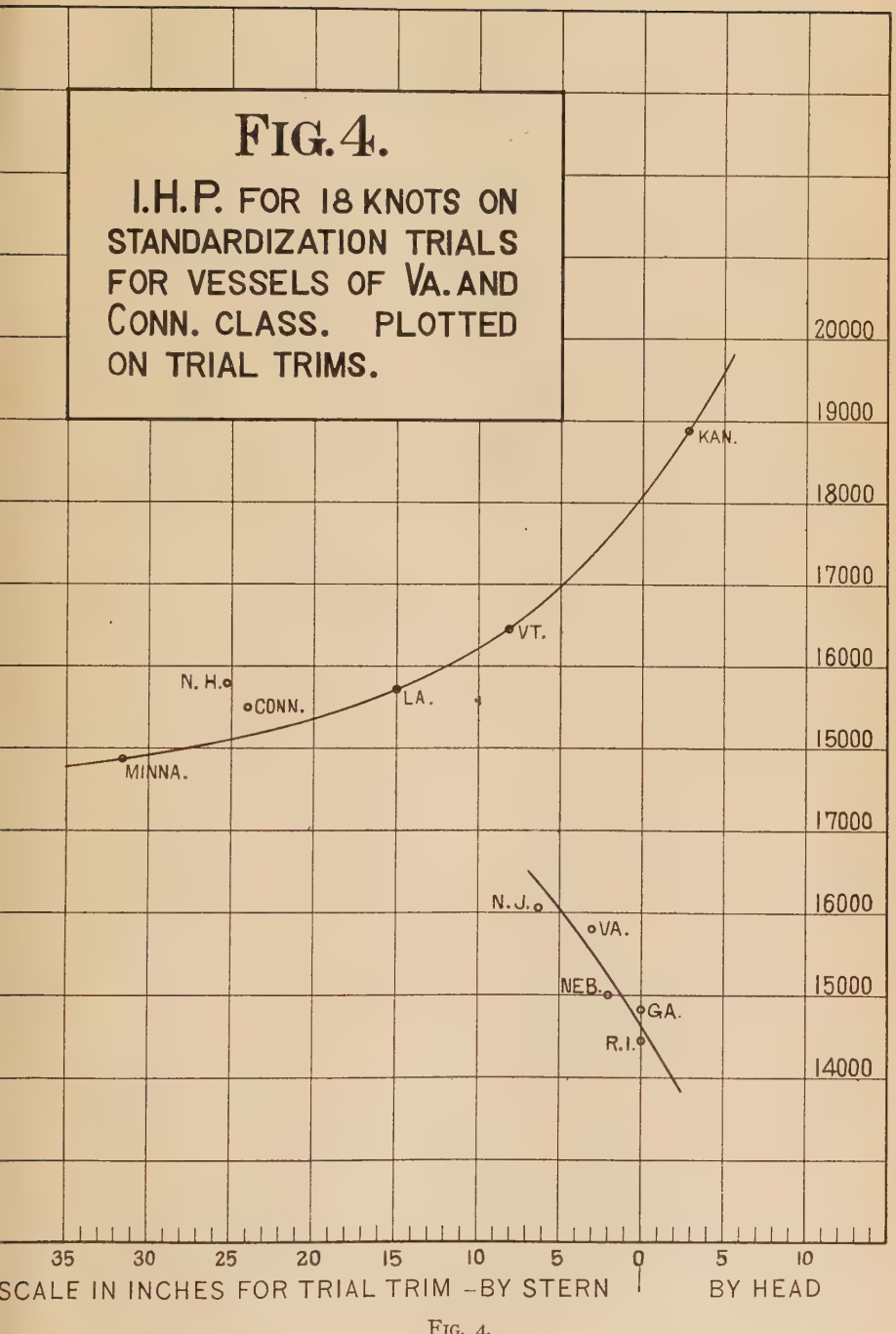


FIG. 4.
I.H.P. FOR 18 KNOTS ON STANDARDIZATION TRIALS FOR VESSELS OF VA. AND CONN. CLASS. PLOTTED ON TRIAL TRIMS.
20000
19000
18000
17000
16000
15000
17000
16000
15000
14000
KAN.
VT.
N. H.
CONN.
LA.
MINNA.
N. J.
VA.
NEB.
GA.
R. I.
35 30 25 20 15 10 5 0 5 10
SCALE IN INCHES FOR TRIAL TRIM – BY STERN BY HEAD
SCALE FOR I.H.P.-VIRGINIA CLASS
SCALE FOR I.H.P.-CONNECTICUT CLASS

FIG. 4.

If we accept the conclusion that the differences of horsepower shown in Fig. 4 are all due entirely to the differences in trial trim it follows that in the case of the *Connecticut* class trim by the stern is advantageous and in the case of the *Virginia* class it is very markedly disadvantageous.

As a matter of fact, there are entirely too many variables involved in these trials apart from the unavoidable inaccuracy of all trial data to warrant any general conclusion being drawn from the variation of trim alone.

For instance, the curve connecting the *Kansas, Vermont, Louisiana* and *Minnesota* results is given its characteristics almost entirely by being passed through the spot for the *Kansas*.

It has been well established since the trial of the *Kansas* that the excessive horsepower she showed on trial was due to the type of propeller with which she was fitted. Even in the "Wasted Horsepower" paper we find on page 213 the following statement: "The propellers of the *Kansas* have been changed since the above data were taken and less power is now needed in order to make 18 knots; the horsepower necessary to make this speed more nearly approaches a mean of her sisters."

This being the case to still assume that the excessive horsepower shown by the *Kansas* was due to her trim alone and to base sweeping conclusions upon this assumption as is done in the paper upon "Wasted Horsepower" appears rather remarkable.

It may be remarked in passing that on page 213 of the "Wasted Horsepower" paper a statement is made in comparing the *Minnesota* and *Kansas* that "on the *Kansas* 4950 horsepower were apparently wasted." Table 5 on the same page, however, shows that the *Kansas* took at 18 knots 3950 horsepower more than the Minnesota instead of 4950.

It does not appear necessary to pursue further the discussion of the evidence and arguments brought forward in the "Wasted Horsepower" paper. The author's main conclusion as regards trim appears to be that trim by the stern is necessarily beneficial. The results of the *Virginia* class shown in Fig. 4 are alone sufficient to refute this conclusion if, following the method of the "Wasted Horsepower" paper, we are to assume the trial data exact and that all the differences shown are due to variation of trim.

Following this method it is very easy to reach all sorts of absurd conclusions. For instance, in Table III below will be found the average indicated horsepower to make 18 knots for the four most recent classes of completed battleships with reciprocating engines. In the case of the *Connecticut* class the *Kansas* is not used on account of her abnormal results which were due to abnormal propellers. The average displacements of the classes of vessels are also given.

TABLE III.—FROM RESULTS OF STANDARDIZATION TRIALS.

Vessels.	Average Trial Displacement—Tons.	Average I. H. P. for 18 Knots Speed.
Georgia, Nebraska, New Jersey, Rhode Island, Virginia	14,943	15,225
Connecticut, Louisiana, Minnesota, New Hampshire, Vermont	16,084	15,692
South Carolina, Michigan	16,050	13,090
Delaware	20,209	12,350

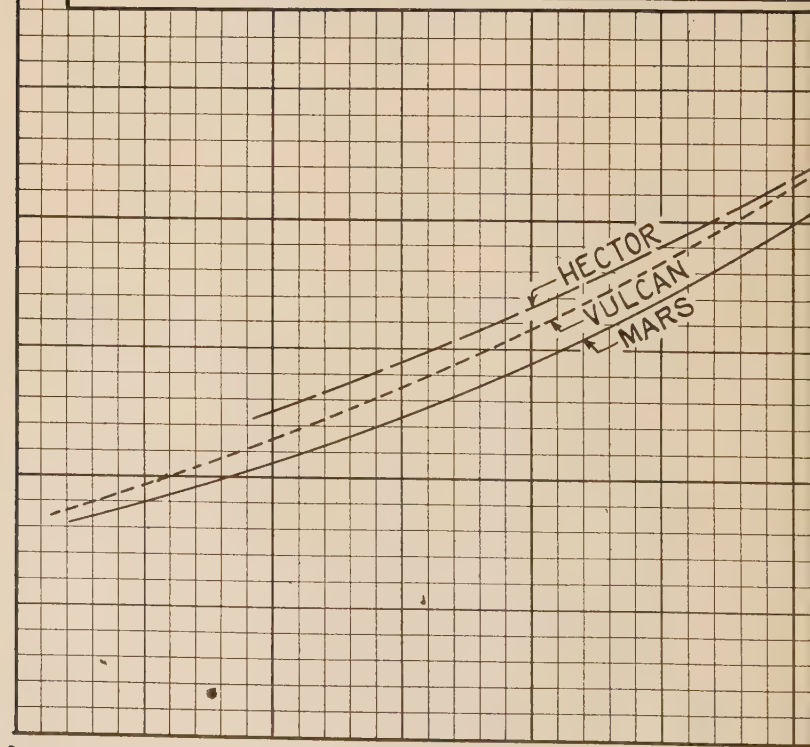
It is seen that the *Delaware* of 33⅓ per cent more displacement than the *Virginia* class made 18 knots on trial with nearly 20 per cent less power. It does not follow, however, that increase of displacement involves of itself less resistance. The decreased power of the *Delaware* is not because of her increased displacement but in spite of it. Again considering the South Carolina class and the *Connecticut* class, the *South Carolina* class has the same dimensions except beam and practically the same displacement. The beam is about 4½ per cent greater and the power for 18 knots about 17 per cent less.

It would not be safe, however, to conclude that the greater the beam the less the power. In some cases it is possible to decrease the resistance for a given displacement, length, and draught, by increasing the beam and modifying the model, while in other cases this process would result in a material increase of resistance.

CURVES OF I.H.P. FROM STANDARDIZATION T

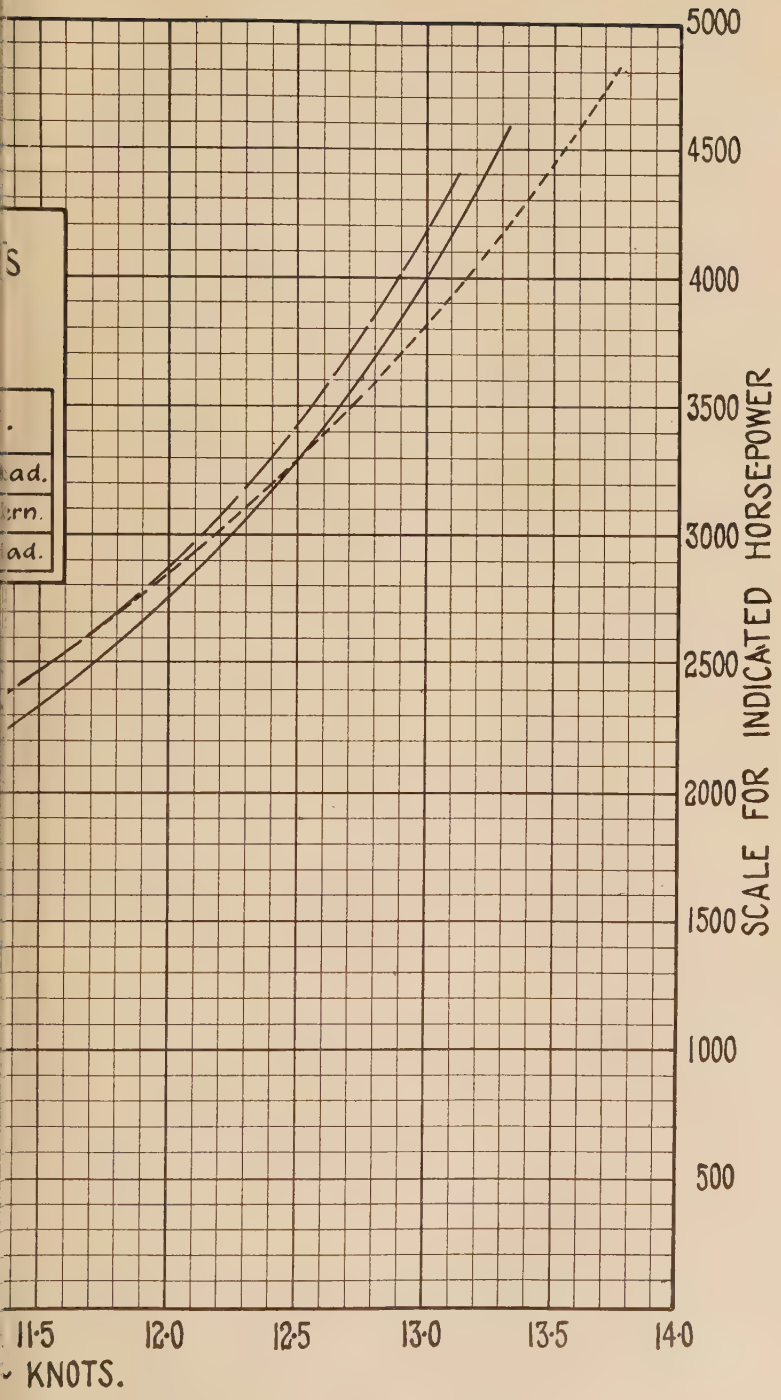
OF MARS, VULCAN, AND HECTOR.

Name	Where Standardized.	Date of Standardization	Mean Draught.	Displacement. Tons.	
MARS.	Del. Breakwater.	Aug. 18, 1909.	24'-8½"	11282	2
VULCAN.	" "	Sep. 15, 1909.	24'-7½"	11240	2
HECTOR.	" "	Oct. 14, 1909.	24'-7⅜"	11235	



8·0 8·5 9·0 9·5 10·0 10·5 11·0

SCALE FOR SP


5000
4500
4000
3500
3000
2500
2000
1500
1000
500
SCALE FOR INDICATED HORSE-POWER
11·5
12·0
12·5
13·0
13·5
14·0
KNOTS.

The conclusion that trim by the stern is necessarily beneficial to speed is inconsistent with a number of results of practical experience. For instance, in Fig. 5 will be found curves of I. H. P. on trial of the three colliers of the *Mars* class. These were sister vessels tried on the same course by the same Board under practically the same conditions. It is seen that up to 12 knots, which was the contract speed, the *Mars* which was materially by the head took less horsepower than the *Hector* which was slightly by the head and the *Vulcan* which was slightly by the stern. The differences shown, allowing for unavoidable errors of observation, are not large. It may be remarked, however, that experiments showed that the model of these colliers towed somewhat more easily when trimmed by the head.

During the recent trials of the *Michigan* on three courses of different depths some special trials were made to investigate the question of the effect of change of trim upon speed.

On June 2, 1910, the *Michigan* was standardized on the Delaware Breakwater course. She was trimmed 16″ by the stern. On June 3, 1910, two series of three runs each were made, one with the ship 3⅜″ by the head, the other 42″ by the stern. The displacement for all conditions was within a few tons of 16,000, *and thus practically the same.* Observers, etc., on all trials were the same and as they had shortly before run several standardizations of the *Michigan* on other courses, and as all trials were run within two days, it is reasonable to suppose that observation errors on these trials were reduced to a minimum and that the *only* factor materially changed was the trim of the vessel.

The Trial Board plotted and considered the results and stated: "The results may be summarized as follows: For a speed of 18½ knots the following H. P. was developed:

Condition (a)	(1′ 04″ by stern)	15,430
" (b)	(0′ 03⅜″ by head)	15,650
" (c)	(3′ 06″ by stern)	16,725

For 16,000 H. P. the following speed was obtained:

Condition (a)	(1′ 04″ by stern)	18.62 knots.
" (b)	(0′ 03⅜″ by head)	18.57 knots.
" (c)	(3′ 06″ by stern)	18.36 knots.

It is seen then that the *Michigan,* when tried with care and skill above the ordinary and under conditions where practically

the only variation was in trim, ran a little better trimmed 16″ by the stern than trimmed 3⅜″ by the head, the difference being, however, not material. When trimmed 42″ by the stern she required over 1000 H. P. more to make her contract speed—18½ knots—than when nearly on an even keel. Model experiments with the *Michigan* did not indicate material change of resistance for the variations of trim concerned and it would seem that in this case, even allowing for data inaccuracy, change of trim by the stern may have affected the efficiency of propulsion prejudicially. The water on the course is only from 20 to 25 fathoms deep and in deep water the results might be slightly different but personally I hold the somewhat heretical opinion that for smooth water work deep immersion of the screws is apt to be prejudicial to efficiency. However, that may be there is no question that there is no appreciable "Wasted Horsepower" when the *Michigan* is trimmed three inches by the head, the trim which is alleged to have caused a "waste" of nearly 4000 H. P. in the case of the *Kansas*. It does not appear necessary to multiply instances.

As regards trim, I believe the following statements fully warranted.

1. So far as can be inferred from trials of the *Greyhound* and large numbers of trials in model basins, ordinary variations of trim of actual vessels cause variations of resistance which are entirely secondary in their nature.

2. There is no evidence which will stand analysis to show that actual ships show material variations of horsepower for small variations of trim or that change of trim by the stern is necessarily beneficial.

3. "Enormous loss of wasted horsepower" due to trim was deduced by erroneous methods from inaccurate data.

In concluding this rather discursive paper I should like to make a few remarks taking as a text the quotation below from page 199 of the paper of "Wasted Horsepower and Economical Trim"—"Ships in commission and displacing 1000 or 1500 tons more than when running their contract trials often equal or exceed the contract speed. And no reasons are usually given; but certainly there are causes for such astonishing results! Why is it that these increased displacements, in such a large number of cases, make such small differences in speed on full-power runs?"

As our vessels do not carry official explainers of "astonishing results" it is not surprising that "no reasons are usually given" but as a matter of fact these results are not astonishing and the reason is very simple. Other things being equal, when a ship develops more power she will go faster and if a vessel in commission develops more power than on her contract trial and is in equally good condition for speed the contract speed will necessarily be exceeded if the displacement is the same as on the contract trial. Moreover, many ships can reach a given speed at a materially increased displacement for a comparatively small increase of power. The reason is simply that the resistance does not increase in proportion to the increased displacement. Hence if the power of the contract trial is exceeded the contract speed, in spite of the increased displacement is likely to be equalled or exceeded.

Some years ago it was an unusual thing in the service for ships in commission to develop as much power as on contract trials. Naturally they did not develop as much speed. It was convenient to ascribe the falling off of speed to the increase of displacement in commission over trial displacement and to say very little about the falling off in power. I believe this had a great deal to do with the undoubted prevalence in the service at that time of erroneous ideas as to the reduction of speed due to increased displacement.

During the last few years it has become much more common for ships in commission to develop as much power as on contract trials and one hears much less about the baneful effect upon speed of increased displacement in commission.

The effect of variation of displacement upon resistance is a thing which has been investigated for years at the Experimental Model Basin, the established practice being as a routine matter to test all models of actual ships 10 per cent light and 10 per cent heavy as compared with the designed normal displacement. In addition special investigations of other displacements are often made.

Broadly speaking, the effect of variation of displacement is materially greater in the case of small fast vessels than in the case of large vessels of moderate speed. The situation may be fairly well typified by Fig. 6 which shows for the *Connecticut* at 18 knots and the *Dahlgren* at 30 knots the effect upon speed of variation of displacement, assuming that the indicated horse-

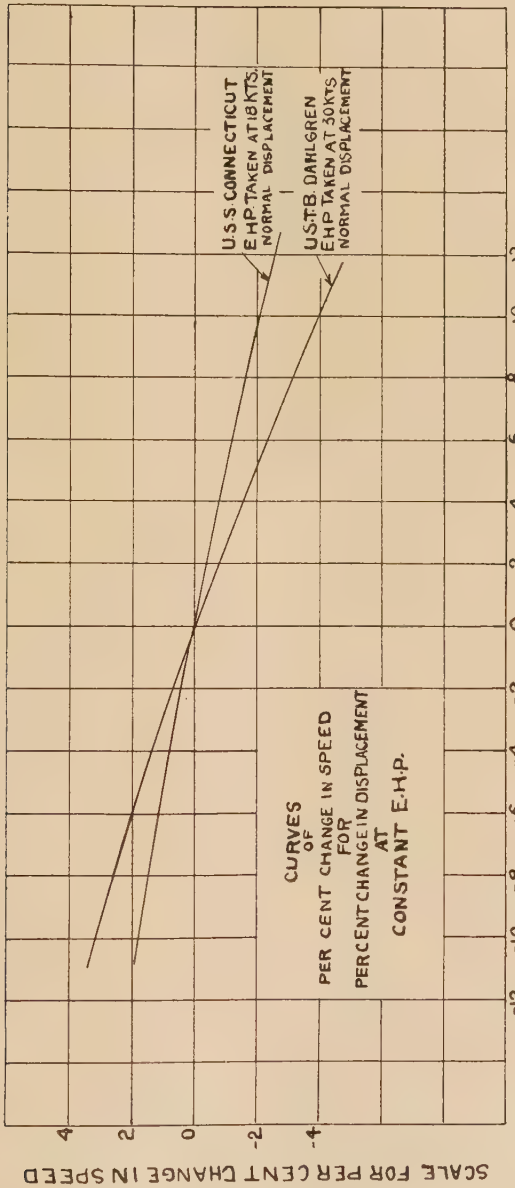

U.S.S. CONNECTICUT
E.H.P. TAKEN AT 18 KTS.
NORMAL DISPLACEMENT
U.S.T.B. DAHLGREN
E.H.P. TAKEN AT 30 KTS.
NORMAL DISPLACEMENT
CURVES
OF
PER CENT CHANGE IN SPEED
FOR
PERCENT CHANGE IN DISPLACEMENT
AT
CONSTANT E.H.P.
SCALE FOR PER CENT CHANGE IN SPEED
4
2
0
-2
-4
SCALE FOR PER CENT CHANGE IN DISPLACEMENT
-12
-10
-8
-6
-4
-2
0
2
4
6
8
10
12

FIG. 6.

power would change in the same proportion as the effective horse-power which, of course, is substantially the case. The *Connecticut* for a 10 per cent variation of displacement should show about a 2 per cent variation of speed only. That is to say, if for a given power she would make 18 knots at 16,000 tons, she should make 17.64 knots for the same power at 17,600 tons, and a little under 18.36 knots for the same power at 14,400 tons.

The *Dahlgren* at 30 knots would fall off 1.2 knots for an increase of 10 per cent of displacement, power remaining unchanged, and gain a little less than a knot for a decrease of 10 per cent of displacement. I do not believe that in the case of any of our battleships would the variation of displacement in service affect the speed for a given power as much as the variation in foulness of the bottom or the variation of condition of the sea from smooth to moderately rough.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE U. S. NAVAL WAR COLLEGE.

(CONCLUDED.)

By REAR-ADMIRAL S. B. LUCE, U. S. Navy.

When Captain Mahan was detached from the War College, May 10, 1893, the command devolved upon Commander C. H. Stockton, as related in our previous article. That officer reported to the Navy Department that arrangements had been made at the College for the summer's course—the course of 1893—but no class was ordered. Though not realized at the time, this was the most critical period in the life of the College. It appeared, subsequently, that the Navy Department had already decided to abolish the College. The assigning of one-half of the quarters in the College building to the use of officers of the Training Station, was only a preliminary step towards its total extinction; and the turning over of the entire building to the Training Station. It was to carry out this settled purpose that the Secretary of the Navy visited the Station in August of that year, 1893. Two causes, however, led to a change of opinion on the part of Mr. Herbert. A copy of Captain Mahan's "The Influence of Sea Power upon History," then recently published, had been placed in his hands. This he read while on board the *Dolphin*, and on being told that the book was made up mainly of lectures delivered at the College, he exclaimed, in effect, that that work, alone, was worth more than all the War College had cost. That book, in short, gave him the first clear insight into the objects and ends of the new institution and led him to revise his estimate of it, as related in the previous number. Another cause which prevented the College from passing out of existence at this time was the active and friendly interest of Captain Taylor. A warm and steadfast adherent from its earliest inception, of the basic idea of an advanced course of professional study, the late, and greatly lamented Rear-Admiral Harry C. Taylor, was ever the

ready friend and earnest advocate of the proposed plan. To a tenacity of purpose he added the art of diplomacy, always presenting the question at issue calmly, logically and in a clear light. This together with an engaging manner enabled him to win friends to the cause and when, in the autumn of 1893, he was ordered as President of the College he had gained for it, through his own personal efforts, a number of influential supporters. It is due to this lamented officer that his services to the College should receive full recognition. On his accession to the chair the tension which had so long kept affairs in an unsettled state was at its height but gradually became relaxed. He administered the affairs of the College with marked ability and his services generally were of inestimable value.

Another officer to whom the College owes a deep debt of gratitude is Captain William McCarty Little, U. S. N., who vigorously fought its battles when the great body of the service was either actively opposed to it, or wholly indifferent. The Naval War Game is his special contribution to the work. It was he who demonstrated all the possibilities of that method of investigation—now known as the laboratory method.

In the Preface to "The American Kriegsspiel, A Game for Practicing the Art of War," by Major W. R. Livermore, corps of Engineers, U. S. Army, 1898, we find the following: "The Navy has not been behind the Army in taking up the idea, as suggested at first by Lieutenant Wm. McC. Little, U. S. N., and the Naval Kriegsspiel [the War Game] has been so developed by the officers of the Naval War College that it forms an essential feature of its work." We are told further that "the American Kriegsspiel has been developed from that of the Germans, its purpose being to represent military operations upon a geographical, or topographical, map by small colored blocks, and auxiliary apparatus to which conventional meaning is assigned." Lieutenant Little was quick to perceive the possibilities of this method when applied to naval operations.

It was through the ingenuity of devising and working out details, and the indefatigable labors of Lieutenant Little that the Naval War Game became a recognized part of the College curriculum. His work has contributed very largely to whatever success the College has achieved. His first lectures (six in number) on the War Game were delivered at the College in the summer of 1887.

That the Naval Game Board has its limitations goes without saying. It does not cultivate what is called "nerve," nor does it improve the *coup d'oeil;* and it presupposes favorable conditions for the manœuvering of fleets. But by its means can be demonstrated what should be done with a fleet, if possible, when battle is imminent, and particularly what should *not* be done. This lifts the question of battle tactics out of the hazy field of conjecture. Some very plausible methods of carrying a fleet into action have been shown on the blackboard to ensure success; but which have been proved on the game board to be wholly impracticable. By working out, by means of the game board, a number of *Don'ts,* all visionary schemes of battle tactics may be eliminated, leaving any one of a few safe and thoroughly practical methods to be adopted by the Commander-in-Chief as in his judgment the circumstances may warrant.

War is no time for experimentation.

That the game board has an interesting history in no way detracts from the credit due to Lieutenant Little for reviving it, and bringing it into almost daily use. The idea of the game board for the practice of fleet evolutions originated, singular to relate, with a Scotch country gentleman of the name of John Clerk (1728-1812), otherwise known as the Laird of Eldin. Thwarted in his early ambition to be sent to sea he became an earnest student of naval affairs. Struck by the barren results of a number of the great fleet fights of the French wars he devised certain manœuvres which would, he believed, lead to breaking through the enemy's line, doubling on, and overwhelming, part of it and compelling the rest either to close action or flight.

Nelson is said to have been a careful student of Clerk's book. His celebrated Memorandum of October 9, 1805, in directing the attack from a position to windward, piercing the allied center and cutting off the rear, adhered closely to Clerk's method. Though the details were modified the principle remained intact. "This must be considered," says Laughton, "as Clerk's grand achievement." *

* General Sir Howard Douglas, son of Sir Charles Douglas who was Rodney's Fleet Captain, has established the fact that Rodney was in no sense indebted to Clerk for his victory of April 12, 1782. But there is the highest authority for saying that Clerk's theorizing contributed largely to the English naval successes during the wars of the French Revolution. (See Sir John Knox Laughton in Dictionary of National Biography, London, 1908.)

Clerk's own account of his method relates that "having convinced myself of the effects that would follow a change of system (of battle tactics) it was my practice to criticise the methods of carrying a fleet into battle by fighting them over again by means of small models of ships which I constantly carried in my pocket, every table furnishing sea-room."

Fine seamen as they were and hard fighters the English naval officers of the times referred to appear to have given no attention whatever to the art of naval tactics. Clerk's work called that fact to their notice and materially influenced the battle tactics of the English navy. To-day the case is somewhat similar. Our officers have given their attention almost exclusively to the development of *matériel.* It is to the credit of Lieutenant, now Captain Little, that he has kept alive at the War College the interest in the naval *Kriegsspiel,* which is only an elaboration of the device of the Laird of Eldin.

The U. S. Army War College.—A college for an advanced course of professional study for army officers to be known as the Army War College was established by General Orders No. 155. Adjutant-General's Office, Washington, D. C., November 27, 1901.

The proposition for the study of the higher branches of the naval profession was readily accepted abroad and the success and rapid development of the several Naval War Colleges of Europe have been somewhat remarkable. The great powers take their naval establishments seriously.

England's Naval War College.—Mr. Julian S. Corbett, Professor of History at the Royal Naval War College, Portsmouth, England, is so well and so favorably known in this country through his many valuable contributions to the literature of the naval profession that everything coming from his pen must be received with the respect which is its due. In the London *Times* of June 5 and 9, 1906, he made a very stirring appeal for what was called in England the "War Course." He writes:

> About half a century ago the service (naval) found itself face to face with a revolution in *matériel.* It was not merely a question of a new method of propulsion, but of new ships, new means of defense and new weapons of attack. For the time question of *matériel* inevitably dwarfed all others.
>
> So complete was the preoccupation that in spite of such warnings as the battle of Lissa, in 1866, there was a tacit assumption that superiority

at sea meant little else than superiority of *matériel.* In perfecting its weapon the navy had forgotten the art of war. It was not, however, till 1900 that a real start was made to put things right and then only in the most tentative way. It was simply decided to establish experimentally at the Royal Naval College, Greenwich, a "War Course" for Captains and Commanders, designed broadly on the lines of the American War College. . . . . The "War Course" has shown itself capable of performing for the service one of the three great functions which, on the continent, are performed by a General Staff. It has shown itself capable of assisting officers to fit themselves for high command; it quickly made itself indispensable to the machinery of the admiralty. It was not intended that it should supply war plans in the authoritative manner of a General Staff. This function cannot be separated from the person of the first Sea Lord. But it was intended to prepare, "when directed," and in a purely advisory spirit, plans of campaign for the consideration of the Admiralty. . . . . The fact has to be faced that after all these years of strong endeavor, there is *to-day no machinery* at the Admiralty for the preparation of plans of campaign. When anything of the kind is required it has to be done by the first sea lord himself, either alone or with the assistance of such a committee as he can scrape together. Everyone is now agreed that this machinery must be found and found quickly. . . . . *No attempt must be made to turn the War Course into anything like another General Staff.**

After some further remarks of great interest, but too full for quotation, the writer continues:

Starting in this way, the expanded War Course will assist everyone and interfere with none. It will be doing no more than providing a laboratory where the lost art of war can be recovered and where officers destined for high command can learn it. There, too, all that is best in naval thought will be gathered in fresh from the sea and spun into threads which the Admiralty and the Committee of Defense can handle with confidence and weave into the fabric of our policy.

We have quoted this eminent authority somewhat at length for the reason that he shows such an intelligent appreciation of the true relations between the functions of a War College and those of a Naval General Staff.

A Board of Admiralty, English or American, must have in close touch with its principal—(First Lord or Secretary of the Navy)—an office devoted exclusively to the preparation of naval campaigns and cognate duties. The province of the War College

* The subject of "A Naval War Staff" has been under discussion in the English press for several months past. The United States Naval Institute, Vol. 35, article Naval Strategy, plate facing page 105, shows the Brain of the Trafalgar Campaign.

The problem of the best form of a 20th century naval administration is still awaiting solution.

is to enable officers to prepare themselves for that particular kind of duty as assistants to the Chief of the Division of Naval Operations. For that reason the War College must be a place where officers may devote themselves *to study*—the study of the higher branches of their profession.

Since the appearance in the London *Times* of Mr. Corbett's admirable articles, great progress has been made in the English War Course; it has grown to be the Naval War College. At the Royal Naval War College, Portsmouth, England, the course now consists of Playing the Tactical War Game, Playing the Strategical War Game, studying and writing reports on the various problems arising out of the strategical conditions of the present day, and lectures on Naval History, Naval Architecture, Steam, International Law, the Law of Evidence, Wireless Telegraphy, Coast Defense, etc. By the latest information at hand there were attending the College five rear-admirals, eleven post-captains and sixteen commanders.

German Naval War College.—From the high military character of the Germans and the thorough manner in which they conduct all their educational departments we may well believe that their Naval War College is worth a careful study. They give much more time to the study of war and its various branches than we are able to allow; and more officers attend than we can spare. All reports from there agree in saying that they are obtaining excellent results.

One thing may be affirmed of the Germans in relation to the development of their Navy. They are thoroughly in earnest.

In the *Revue Maritime,* Vol. 178, of 1908, July, August and September, will be found quite a full and a very interesting account of the War Colleges of England, Germany, France, and Italy. This renders any special notice of them here unnecessary.

The Naval War College of Japan is modeled somewhat after the U. S. Naval War College. The number of students depends upon the exigencies of the service. The course is two years long and consists mostly of laboratory work. The class is sent out with the fleet to witness tactical exercises, a feature regarded as very important. On graduating, which is made an occasion of ceremony the students receive diplomas, and even prizes for those who excel.

The Japanese "mean business," if one may be permitted the use of such an expression.

French Naval War College.—"The end and aim of the Naval War College is to build up a military system upon solid and enduring foundations," writes Captain Darrieus.* "It was in obedience to this precise thought," he says, "that the founder of the College, M. E. Lockroy, the Minister of Marine of 1895-6, gave it the name of the Naval *War* College. He wished thus to indicate the primary importance which he attached to making tne great and fruitful concept of war the ever guiding star of his labors."

In another place the author quotes Moltke as saying: "*Our campaigns and our victories have instructed the French, who like us have numbers, armaments, and courage. Our strength will be in management, in leadership, in one word in the General Staff. This strength France may envy us; she does not possess it.*"

"The creation of the Naval War College," the author tells us, "was the first step towards a General Staff, as necessary in the preparation for naval war as in that for a war on land, and which must be realized some day, when minds are better prepared for it after generations of officers have passed through the College." "Of the various problems growing out of the complex character of the naval organization it may be confidently affirmed that Strategy and Tactics are its master key and best express its essence; all other problems will lend themselves to the solution of this fundamental problem of the military art. It is that which will form the strong roots by which the general growth will be nourished."

Of strategy in particular he says: "It is the fruit of long and patient meditations, of far-sighted measures taken long in advance and requiring slow but unbroken effort through many years. In fact, strategy touches upon all problems of war; it is their very soul; its field of action is unlimited and many volumes could be devoted to it without coming near to exhausting the subject." He then quotes Von der Goltz, Clausewitz, Jomini, Napoleon and others to sustain his position.

Marine International Law.—Rear-Admiral C. H. Stockton, U. S. Navy, prepared the Naval War Code of 1900 as mentioned in our previous article.

In 1901 a method of discussing international law questions was

*War on the Sea, by Gabriel Darrieus, Captain, French Navy. Professor of Strategy and Naval Tactics at the Naval War College, France. Translated by Philip R. Alger, Professor, U. S. Navy.

introduced by Rear-Admiral Chadwick. It is best explained by the following preface to the "International Law Situations with Solutions," issued by the President of the College:

The studies in international law at the Naval War College during the summer of 1901 were under the immediate direction of Mr. John Bassett Moore, late Assistant Secretary of State, now of Columbia University. The mention to the service of his name gives assurance of the value of the present work. To his able and careful labors in the present instance the college is deeply indebted.

The situations were set by Mr. Moore, and tentative solutions were sent in by the several committees into which the officers in attendance are divided for college work. The tentative solutions were then discussed orally, the discussions being presided over and directed by Mr. Moore, who prepared and read the accompanying notes, and who is also the author of the paper in the appendix, entitled "Maritime Law in the War with Spain." The printed solutions exhibit the consensus of opinion of all concerned.

It is believed that by proposing cases simulating those which have recently arisen, or which seem likely to arise under modern conditions, and bringing to bear in mutual discussion the thought and experience of the officers who make application of the law, and the trained mind of the international jurist who expounds it, a method has been adopted which must give to these solutions a practical value of great interest and weight.

The results are submitted to the service in the surety that they represent a valuable addition to work in a domain of thought which belongs peculiarly to navies.

F. E. CHADWICK,
Captain, U. S. N., President.

NAVAL WAR COLLEGE, Newport, R. I., September 5, 1901.

The same method was followed in 1902 as will be seen by the preface to the second volume of the new series.

The International Law Situations at the Naval War College during the summer course of 1902 were under the immediate direction of Mr. George Grafton Wilson, Professor in Brown University, whose name is already known to the service through previous papers prepared by him for the College.

As last year by Mr. Moore, this year the situations were set by Mr. Wilson, and tentative solutions offered by the committees into which the officers in attendance are divided for the college work. Throughout the several law periods during the summer there were general, and frequently long-continued, discussions of the solutions by the officers, making the subject a lively one; and more so, that several of the situations were of late occurrence, which the officers concerned have sent to the college for consideration. It is hoped that so profitable a practice will be continued by the officers afloat.

F. E. CHADWICK,
Captain, U. S. N., President.

NAVAL WAR COLLEGE, Newport, R. I., November 19, 1902.

Mr. Benjamin Baker has given a very clear account of the further progress made at the College in this branch of study. We are permitted to quote as follows: *

Two or three specific instances will serve to show the way in which the Naval War College conclusions, apart from the items of the code of 1900 [referred to in our former article], have established sound principles for particular situations and have to a large degree formulated in advance the decisions later adopted by the Powers. One of these instances related to the arrival of the Russian transport *Lena* at San Francisco, during the Russo-Japanese War. The vessel was damaged, and necessary repairs promised to require six weeks or more. This disposed at once of any possibility of observing the twenty-four hour rule. The ship could not be ejected from the port in an unseaworthy condition, in which state she had entered it; and if allowed to refit and then go out, the hospitality of the port would result in aid to Russia against the interests of Japan—consequently a breach of neutrality. The situation was not covered by any accepted rule. The solution actually adopted by the State Department was the interment of the ship until the end of the war, and the same rule was applied to the Russian squadron under Admiral Enquist at Manila. This rule, it is interesting to note, was at that time in print as one of the conclusions of the then latest conference of the War College.

Another instance is the conclusions reached upon the subject of submarine mines by the War College conferences of 1905. The subject was then practically a new one, brought into acute prominence by the events of the War in the Far East. The Naval War College formulated these conclusions:

"1. Unanchored sub-marine mines are prohibited, except those that by their construction are rendered innocuous after a limited time, certainly before passing outside the area of immediate belligerent activities.

"2. Anchored contact mines that do not become innocuous on getting adrift are prohibited."

Compare with these articles Article I of the Hague Convention of 1907—two years later—on the same subject. The Hague text says:

It is forbidden:

1. To lay unanchored automatic contact mines, except when they are so constructed as to become harmless one hour at most after the person who laid them ceases to control them.

2. To lay anchored automatic contact mines which do not become harmless as soon as they have broken loose from their moorings.

The substantial identity of the two sets of articles is certainly striking.

* See "George Grafton Wilson," by Benjamin Baker, Boston Evening Transcript, June 20, 1910.

Another item is the fact that of the topics proposed for consideration in England's invitation to the London Conference, all but two had been the subject of conclusions on the part of the War College conferences which were in nearly all points in harmony with the declaration finally adopted.

An illustration of the authority of the War College conclusions in regard to points not covered by recent international agreements is afforded in a bulky book called "International Law Applied to the Russo-Japanese War," and written by Professor Sakuye Takahashi of the University of Tokio, who was the legal adviser of the Japanese Government during the war. Discussing Japan's treatment of the newspaper correspondents—a matter which gave rise to volumes of complaints from the newspaper men themselves—Professor Takahashi says:

The problem of the treatment of newspaper correspondents is well discussed in the International Law Situations published by the United States Naval College. The author takes the liberty to quote the larger part of the solution (as formulated by the War College) to prove that the Japanese treatment of the correspondents was very reasonable, judging from the American view.

Takahashi then proceeds to quote more than ten pages of the U. S. Naval War College "Situations" of 1904 in support of the policy actually followed by Japan.

This use of the Naval War College publications on international law may well enough serve to point out the great value they have as texts, as collections of authorities and principles, bearing on a great variety of problems, quite apart from their positions as statements of final conclusions. The American delegates to the Second Hague and the London Conferences had reason to be thankful that the whole range of debated and debatable points had been so fully examined in the War College annuals, and that all the documentary materials pertinent had been so adequately presented. The degree of this thoroughness was illustrated at the conference in London when one of the continental delegates presented a proposition (finally embodied in article 54 of the Declaration) as a wholly new matter. It was very interesting to the conference, as a whole, to discover—and it was a discovery for them—that the "new" point was set forth in full detail in one of the War College annuals, with a citation of provisions covering that very point from treaties between the United States and several European countries.

Professor Wilson has been for nine years the technical law adviser of the President and Staff of the War College. He has prepared "situations"; collected and presented the authorities, assisted in discussions, and formulated the conclusions of the conferences; and these have acquired a position of great authority throughout the civilized world. Necessarily, he has been in the most intimate contact with every detail of the country's

foreign relations so far as these concern matters of war; and has a familiarity with current events hardly to be possessed by any other person except the naval officer who actually handles the concrete case. The naval officers who annually meet at the conferences at Newport are men of judgment and wide experience. Their legal adviser very nearly shares their experiences and he brings to the discussion of them a degree of learning which is naturally out of reach of the busy naval officer.

In a letter to the London *Times* by a "Naval Correspondent," April 5, 1901, the Naval War Code prepared by Captain Stockton, U. S. N., is very favorably noticed. The writer remarks that "this little code of laws deserves to be noted as another product of the United States Naval War College, to which we owe Captain Mahan's work on Sea Power." On April 10, 1901, the eminent English authority on International Law, Professor T. E. Holland, wrote to the London *Times:*

It is worth considering whether something resembling the United States Code would not be found useful in the British Navy. Our code might be better arranged than its predecessor, and would differ from it on certain questions; but should resemble it in clearness of expression, in brevity, and above all things in frank acceptance of responsibility. What naval men most want is definite guidance in categorical language, upon those points of maritime international law upon which the government has made up its mind.

Since these letters appeared the English Naval War College has made great progress as we have shown.

All this is very gratifying as far as it goes, but it must not blind us to our defects. The College has not yet emerged from the adolescent stage. While its growth has been in one respect healthy, in others it has been far from satisfactory. In the department of Marine International Law, it has fulfilled the expectation of the friends of the College. In the department of the Science and Art of War it presents a case of retarded development. The time has arrived—is even now here—when the College must go ahead or go back. In the report of the Board of 1884 it said: "The Board is of the opinion that a cogent reason for such a school" (now known as the Naval War College) is that there may be a place where our officers will not only be encouraged, but *required to study their profession proper*—War—in a far more thorough manner than has ever heretofore been attempted, and to bring to the investigation of modern naval warfare the scientific methods adopted in other professions." . . . .

"The School (College) will tend to hold the young officer to those lines of professional thought so eminently calculated to qualify him for the highest and most responsible duties."

It was assumed by the board that six months would be needed for the work of the proposed school. The course of study was divided under two heads:

A. The Science and Art of War.

B. Law and History.

The latter, as we have seen, has far outstripped the principal branch. It is now time to develop the more important course. All the great masters of the Art of War who have written upon the subject, dwell upon the importance of a knowledge of strategy, and the amount of study and reflection required to master it. We give four months to it and a vacant chair of Naval History. Fifteen years ago this was seen to be trifling with a subject admittedly of the highest importance. For that reason the following order was issued:

NAVY DEPARTMENT, WASHINGTON, February 18, 1895.

SPECIAL CIRCULAR No. 20.

1. The Session of the Naval War College and Torpedo School for 1895 will commence on the first day of June next, and will terminate on the 15th day of October.

2. It is the intention of the Department to detail a class of about twenty-five officers (fifteen of and above the grade of lieutenant and ten below that grade) for attendance during the session. From this class it is *proposed to select five officers to remain after the Session to continue the general work through the winter and prepare for the next Session.* These five officers will be chosen for their aptitude in the work, and their attainment in International Law, Strategy and Tactics.

. . . . . .

H. A. HERBERT,
Secretary.

It will be seen from this order that it was the intention of the Department that comparatively young officers who had shown an aptitude for the cultivation of the higher professional branches should remain at the College for *Study;* not to hear lectures, which are very well in their way—but to study. And of all the junior officers in the service it was certainly a very modest assumption that five such officers might be found. That was before the Spanish War when the officers could have been found, had there been anyone in the Navy Department of that day to see that the

orders of the Secretary of the Navy were carried out. To-day all the conditions are different. The scarcity of officers is everywhere felt. The College cannot expect to be favored at the expense of ships in active service. But in the fulness of time when the supply of officers shall be equal to the demand, we indulge the hope that not only five officers may be found but many more.

The value of lectures on professional subjects must not be underrated. They are indispensable. But it is one of the principles of the Science of Education that throughout youth and in maturity the process in the acquisition of knowledge shall be one of self-instruction. Knowledge which the student has himself acquired, a problem which he has himself solved, becomes by virtue of the conquest much more thoroughly his own than it could otherwise be. This is making education a process of self evolution. "Humanity has progressed solely by self-instruction," says Herbert Spencer, "and that to achieve the best results, each mind must progress somewhat after the same fashion, is continually proved by the marked success of self-made men." * What the learner discovers by mental exertion is better known than what is told to him.

When it was proposed in 1884 that Rear-Admiral—then Captain—Mahan should take the Chair of Naval History at the War College, he replied that he did not have the accurate knowledge necessary; that he had not given the subject special attention. If his knowledge of naval history was in that day superficial, no one can say that now it is not profound. On accepting the office he began a course of self-instruction in order that he might instruct others. He was obliged first to possess himself of knowledge. He then organized his knowledge, and in his treatment of naval strategy he resorted to the "comparative method," to which science owes so much. He studied the principles underlying military strategy and then applied those principles, as far as they were applicable, to naval strategy. In a word his method, consciously or unconsciously, was scientific. The works on Sea Power were a great boon to the naval profession, but not greater than the example he set by the practical illustration of what self-instruction can accomplish: an example all should heed.

* "Education," by Herbert Spencer.

Naval history has been for the most part a collection of isolated and independent facts. The ships of one nation encounter, at sea, the ships of another nation with which it is at war. A battle ensues and the results are given by the historian with more or less detail. This is an isolated fact. The historian then proceeds to give an account of another sea fight, and of still another, and so on to the index of the chapter. Thus we have a series of independent facts, each one interesting in itself to the naval student, and worthy of critical examination in all its various aspects. But not satisfied with the historian's bare relation of facts, the student asks himself whether it was through *accident* or *design* that those opposing fleets met and fought at sea. On further examination he finds that there is a relation between these facts. He then uncovers, or discovers, what had been hidden from him that these several facts are all related to each other. What then had appeared to him as a series of independent, unrelated facts, he finds out to be phenomena which fall within the province of law. In short he has, by self effort, gained knowledge; he has organized that knowledge, and has worked out for himself the science of Naval Strategy. "Science is organized knowledge."

There is a still higher field of inquiry. Why were those two nations at war? The causes which led to our War of 1812 have been traced back for nearly one hundred and fifty years.

Let us continue our lectures by all means. But let us also find a few officers who are not only willing but anxious to specialize on the lines laid down by the author of Sea Power. To such the War College extends a cordial welcome.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

GUN EROSION.

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In the Journal of the American Society of Naval Engineers for May, 1910, in an article on the subject of gun erosion, Lieutenant-Commander H. E. Yarnell, U. S. N., advances a theory of the cause of erosion which, though once generally accepted and still frequently put forth by writers on ordnance, is, I believe, erroneous and susceptible of being proved so.

As stated by Mr. Yarnell, this theory is that "*gun erosion is caused by the escape of the highly heated gases of combustion through the minute openings between the rotating bands and the bore of the gun before and shortly after the projectile begins to move. After the shell has advanced sufficiently far to enable the copper rotating band to mould itself to the form of the rifling the erosion decreases to a considerable extent.*"

Now erosion as it occurs to-day in U. S. naval guns is a smooth wearing away of the bore, beginning in rear of the rifling and extending further and further down the bore as the firing is continued. This wear is greatest at the rear, and is about twice as great on the lands as in the grooves, so that its effect is to make the bore slightly conical from the front of the powder chamber forward and to gradually obliterate the rifling. Thus, for example, in a 12-inch 45-caliber gun with 2700 f. s. muzzle velocity, after 100 rounds of nitro-cellulose powder have been fired, the diameter across the lands at the origin of the rifling will have been increased from 12″.00 to about 12″.20, and that across the grooves from 12″.10 to about 12″.22, and this wear will regularly diminish towards the muzzle so that at 10 or 12 calibers forward of the origin of rifling it amounts only to 0″.002 or 0″.003 on the lands and nothing in the grooves.

From the point where the erosion just described ceases, the bore seems to be practically unaffected by continued firing and the rifling remains perfect until within a few calibers of the muzzle, where wear again becomes apparent. This muzzle wear, however, seems to have no relation with ordinary erosion and at any rate is of little or no importance, seldom exceeding a few thousandths of an inch, even in large guns after enough firing to have caused really serious wear at the breech end. Its cause is believed to be the attrition of the powder gases as they escape from the muzzle with greatly accelerated velocity after the exit of the projectile.

Coming back to the erosion proper at the breech end of the gun, the following objections to the theory of its cause advanced by Mr. Yarnell seem to me to be conclusive:

(1) The forward slope of the powder chamber and the bore behind the rammed-home position of the projectile erode, the rate of wear of the bore just in rear of the rotating band being the same as that of the bottoms of the grooves at the beginning of the rifling. This wear cannot be accounted for by escape of gas past the projectile.

(2) In the rammed-home position of the projectile and until it has moved forward enough for its rotating band to be forced into the rifling, the grooves offer comparatively free passages for the escape of gas; moreover there is at all times much closer contact between the copper band and the tops of the lands than there is between it and the bottoms of the grooves. Consequently the wear of the bore would be chiefly, if not wholly, confined to the grooves were it caused by escape of gas past the projectile. As a matter of fact the wear of the tops of the lands is about double that of the bottoms of the grooves.

(3) The pressure of the gas, which is only about 2 tons per square inch when the projectile begins to move, increases rapidly, attains its maximum of 15 to 18 tons when the projectile has moved from 6 to 10 or 12 calibers along the bore, and then decreases slowly. The linear expansion of the bore abreast the rotating band also increases as the projectile moves forward, both on account of the increasing powder pressure and on account of the diminishing thickness of the gun wall, the maximum enlargement of bore probably occurring when the shell is about half way to the muzzle. Moreover the driving edges of the rotating band

wear away as the projectile moves. Consequently there should be a very much greater escape of gas past the shell after it has moved a few calibers than when it has merely moved enough to force its band into the grooves, and the greatest erosion, if it were caused by gas escape, would not occur at the beginning of the rifling but further down the bore.

(4) The latest type guns have much greater muzzle velocities than earlier types mainly because of their larger powder chambers that allow the use of larger charges of powder without much increase of maximum pressure. If the pressure curves of such guns are compared, it will be found that from the origin up to the point of maximum they do not differ much, the greater velocity given by the larger charge being mainly due to the more sustained pressure from the point of maximum to the muzzle. The conditions relating to the escape of gas past the projectile before it moves and during the early stages of its motion are, therefore, almost the same in high power and in low power guns of the same caliber using the same sort of powder with about the same maximum pressure. But there is an immense difference in the erosions of such guns; a 12″ Mark II gun that has been fired 500 rounds with velocities not exceeding 2100 f. s. is only eroded to about the same extent as a 12″ Mark V gun after 50 rounds with 2700 f. s. This is clear proof that erosion depends upon the quantity of gas (number of heat units) behind the projectile as well as upon its quality (pressure and temperature), whereas the amount of gas that escapes past the projectile and its erosive effect can only depend upon pressure and temperature (the time of action being considered constant).

(5) Experiments with gas escaping through vents having shown that copper is worn away more rapidly than gun-steel, the rotating band, past which all the gas that is supposed to erode the bore must escape, should be much more eroded than any part of the bore by a single round. As a matter of fact the rotating bands of fired projectiles show no signs at all of erosion.

If the foregoing objections are valid, as they seem to me to be, it is impossible to reproduce the conditions of gun erosion by the escape of the products of combustion of gun powder through vents. Yet the numerous experiments that have been made in this line have some value since they demonstrate that the higher the temperature of the gases and the lower the melting point of the

metal attacked, the more rapidly is the surface softened and worn away. The actions in the two cases are not identical, but they are near enough alike to allow some conclusions to be drawn from one case that will apply to the other.

On the other hand, we must guard against concluding too much. For example, the amount of metal worn away by the gas escaping through a vent can be made to vary materially by altering the method of ignition of the powder, everything else remaining unchanged; while, in the case of a gun, erosion is not appreciably affected by the character of the ignition. And, again, the use of water, paraffin and other substances may greatly reduce the erosion caused by gas escaping through a vent, while in guns they would be ineffective unless used in such quantities as to reduce materially the ballistic results.

Considering erosion as it actually occurs in a gun of any given caliber, it may be shown to depend upon three factors—temperature of combustion, weight of charge and time of action.

(a) *Temperature of combustion* is generally recognized to be an important factor in gun erosion, and to its higher value in the case of nitro-glycerine powders is properly attributed their greater erosive effect when compared with nitro-cellulose powders. The temperatures of combustion of the Italian ballistite and of the English cordite are from 500° to 600° Cent. greater than that of the pure nitro-cellulose powders used by France and the United States, and how great an effect this difference of temperatures produces is well illustrated by a comparison of the erosions of English and United States naval guns of large caliber. The English 12″ Mark VIII gun is of 35 calibers length of bore and its charge of 167 lbs. of cordite imparts a velocity of 2367 f. s. to an 850-lb. shell. Our 12″ Mark III gun is a 40 caliber gun and has an 870-lb. shell with 2400 f. s. muzzle velocity, the charge being 237 lbs. of nitro-cellulose powder. The maximum pressures are about the same in each case. In the former gun the "probable maximum wear at 1″ from commencement of rifling" is stated in the official *Treatise on Service Ordnance, 1904,* to be 0″.50 after 80 rounds and 0″.76 after 130 rounds. In the latter gun the wear at the same point is only 0″.13 to 0″.15 after 80 rounds and 0″.20 to 0″.22 after 130 rounds. Notwithstanding the cordite charge is 70 lbs. less than the nitro-cellulose charge, its higher temperature of combustion results in nearly four times greater erosion for somewhat less power developed.

It is commonly believed that pressure plays an important part in producing erosion, and experiments have in fact shown that the smaller charge of quick powder (of the same chemical characteristics) causes as much erosion as the larger charge of slow powder required to give the same velocity in a given gun. But the explanation of this is that at the higher pressure more CO_2 and less CO is formed than at the lower pressure, so that the temperature of combustion in the former case is greater than in the latter, and the greater quantity of heat from the larger charge is thus compensated for by the higher temperature of the gases of the smaller charge. The exhaustive investigations of Sir Andrew Noble, recently published, indicate that there is an increase of about 100° Cent. in the temperature of combustion of nitro-cellulose powders for an increase of maximum pressure from about 13 tons to about 18 tons per square inch.[1]

(b) *Weight of charge* is the factor that, for a given kind of powder and a given caliber of gun, plays the predominant part in producing erosion. It is the need of larger charges to give greater velocities that practically limits the power of modern guns by making the wear prohibitive when the power is increased beyond a certain point. It is easy enough to get 3000 f. s., or even more, from a gun of 45 or 50 calibers length of bore, but the weight of charge required generates such an immense quantity of heat that the resulting erosion, even when nitro-cellulose powder is used, is too dear a price to pay for the gain of power.

That even comparatively small guns as now constructed will not stand a velocity much in excess of 3000 f. s. for many rounds is well illustrated by the competitive test of the Brown and Crozier 6-inch wire-wound guns. The program of tests contemplated 250 rounds or more from each of these guns, which had chambers large enough for charges of about 80 lbs. of nitro-cellulose powder, but the Board reported that *due to erosion* the limit of effectiveness for firing service projectiles had been reached in 88 rounds from one gun. The program was then altered to 98 rounds, the last 10 with excessive charges. The average powder pressure for 75 rounds (all that were fired except 13 with reduced and 10 with excessive charges) was 40,375 lbs. per square

[1] For a very important correction of Sir Andrew Noble's results see *Observations relatives aux travaux de Sir A. Noble,* par le Chef d'Escadron Bourgoin, de l'artillerie Coloniale. Mémorial de l'artillerie navale. Part 1, 1909.

inch for one gun and 40,760 for the other. The highest velocity in the first 88 rounds was 3455 f. s. for one and 3533 f. s. for the other gun. In the 10 rounds with excessive charges the highest velocities were 3740 f. s. in one and 3860 f. s. in the other gun. At the end of the test of 98 rounds both guns were completely worn out by erosion of the bore.[2]

Another illustration of the effect of weight of charge is given by a comparison between the U. S. Navy 6-inch guns of Marks IV and VI. The former is a 40-caliber gun with a charge of about 19 lbs. and a muzzle velocity of 2100 f. s.; the latter is a 50-caliber gun with a 30-lb. charge and 2600 f. s. muzzle velocity. If we take the average velocity of the projectile while traversing the bore to be six-tenths its final velocity, the travels in the two guns being respectively 17.2 and 20.7 feet, it will be seen that the time of exposure of the bore at the origin of rifling to the action of the gases is almost exactly the same in the two guns, so that the time factor cannot affect the comparison. The maximum service pressures in the two guns are also not far apart (15 tons in the former and 16 in the latter). But the maximum wear of the gun with 30-lb. charge after 254 rounds is as great as that of the gun with 19-lb. charge after 1198 rounds, besides which the wear extends much further down the bore in the former. (Maximum enlargement 0″.071 in each gun, enlargement 3″ forward of origin of rifling 0″.055 in one and only 0″.029 in the other.) It is true that the 40-caliber gun uses a cartridge case with a mouth cup, while the 50-caliber gun does not, but I can see no reason for supposing that this affects erosion, and the greater erosion of the latter gun must, I believe, be attributed to its larger powder charge.

(c) *The time of action* of the powder gases is the third factor in erosion. Its effect is shown by the greater erosion of long than of short guns using the same powder charge. In the usual case, however, where 5 or even 10 calibers length is added to the bore of a gun to gain 100 or 200 f. s. velocity, the increase of erosion is unimportant because the extra time taken to traverse the bore is very small (on account of the high velocity of the projectile near the muzzle).

[2] It will be seen that the statement made in Mr. Yarnell's article already referred to, that these guns fired 100 rounds each with an average muzzle velocity of 3600 f. s. goes considerably beyond the facts.

Thus far we have considered the erosion of a gun of fixed caliber, but when guns of different calibers are compared the *time of action* becomes the predominant factor in erosion, and a new factor, *relative surface exposed to the gases,* appears.

In similar guns, similarly loaded, as caliber becomes greater, surface area of bore per pound of powder diminishes and time of exposure of that surface to the action of the powder gases increases—the larger the gun, the more heat per unit area of bore and the longer it acts on that area. Hence there is good theoretical ground for supposing that the erosion of similar guns will be proportional to about the square of their calibers, and, in fact, a 12″ gun does wear at least four times as fast as a 6″ gun of the same relative power.

From all the foregoing we may conclude, I think, that the necessary and sufficient conditions for gun erosion are the intense heating of a thin film of metal at the surface of the bore and the movement of the gases over that surface. The temperature must not only be high enough but must be maintained long enough to bring the surface almost, or quite, to the melting point. The larger the gun the less the relative surface to be heated and the longer the time the heat is applied, hence the greater the erosion. Also, the larger the charge the longer the high temperature is maintained and the more the erosion.

That movement of the gases over the heated surface is a requisite for erosion is shown by the fact that the rear part of the powder chamber is not worn away by repeated firings, nor is the inner surface of a bomb in which powder charges are burned for experimental purposes. Whether this movement of the gases rubs off the heated surface of the bore, or merely acts to increase the rate of transmission of heat from gases to bore, I do not pretend to say.

As to the possibility of preventing erosion, the most important thing to do is to use powder having a low temperature of combustion, and the U. S. Navy smokeless powder has the lowest temperature of any in use. No advantage is likely to be had from the use of special metals for the gun tube, ordinary gun-steel being apparently the most resisting material that it is practicable to employ. If we insist upon high power in guns, we must expect them to wear out with comparative rapidity, and the only apparent remedy is relining after a certain number of rounds.

As regards the extent of erosion, many of the statements made, even by persons in a position to know the facts, convey an erroneous idea because they have been based on experience with guns and projectiles not properly designed for the high velocities now common. With a suitable profile of bore and properly proportioned rotating bands a 12-inch gun of 45 calibers length of bore, such as the U. S. Navy 12-inch Mark V gun, using nitro-cellulose powder, will stand 200 rounds at 2700 or 2800 f. s. velocity without material loss of accuracy or falling off in velocity, and a 6-inch gun of equal relative power will probably stand 1000 rounds. Nor is there any danger that the erosion of the guns of a ship will produce variations in their ballistics that will affect the accuracy of salvo firing.

I have not referred to Vieille's *Study of Erosion,* a translation of which forms part of Mr. Yarnell's article, for the reason that it seems to me to relate to a sort of erosion that we do not experience in our present guns. I should not presume to oppose my own opinion to that of the distinguished French engineer who originated our smokeless powder and whose knowledge of interior ballistics, based upon profound study and immense experimental research, is beyond compare, but the date of his article (published in 1901), as well as various statements made in it, seem to me to show that he did not have in mind the conditions we now have to deal with. At all events, since he wrote, much experience has been gained that may well have led to a change of opinion on his part.

As bearing on this subject, the following quotation from the English official *Treatise on Service Ordnance* is interesting:

"Erosion is a general term applied to the effects produced by the action of gas on the bore of a gun. These effects are of two kinds, viz.:

"(1) The gradual enlargement of the bore and smooth wearing away of the surface by the action of the gas in rear of the projectile, which is called wear and is independent of the sealing of the bore by the projectile.

"(2) The irregular eating away of the surface of the bore in holes and gutters, which is called scoring, and is mainly due to windage and imperfect sealing of the bore.

"These two actions may occur separately or conjointly, and with cordite charges the differences are marked.

"In the latest high velocity B. L. guns, in which the sealing is nearly perfect, wear occurs with very slight or no trace of scoring.

"In R. M. L. guns, where there is considerable windage, the scoring is considerable and the wear practically nil, while in the older type of B. L. guns both wear and scoring appear."

The smooth "wear" described in paragraph (1) of the preceding quotation is the only sort of erosion that occurs at the present day in U. S. Naval guns, and the statement that it is caused "by the action of the gas in rear of the projectile . . . . and is independent of the sealing of the bore by the projectile' cannot, in my opinion, be successfully controverted.

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EARLY VOYAGES OF AMERICAN NAVAL VESSELS TO THE ORIENT.

By Charles Oscar Paullin.

VI.

The Affair of Quallah Battoo: 1831-1832.[1]

Within a few years after the *Empress of China* opened the way to the Orient, American merchants established a considerable trade with the Dutch East Indies. Java was the first island visited, the *Empress of China* having stopped there on her way to Canton. The adjacent island of Sumatra was doubtless the next to attract the attention of our shipmasters. Trade with it was begun in 1789 by Captain Jonathan Barnes, of Salem, commander of the brig *Cadet,* who in that year arrived at Boston with a cargo of pepper, spices, and camphor. The traffic in pepper with the Sumatrans soon became quite extensive, and in 1802 no less than 30 American merchantmen visited the island. Salem led its competitors, Boston, New York, and Philadelphia, in the pepper trade. Her shipmasters prepared charts and sailing directions for the coast of Sumatra which were used by both the merchant and national marine.[2]

Among the Sumatran ports most frequented was Quallah Battoo, situated on the west coast in the kingdom of Acheen, a part of the island that had not been brought under subjection by the

[1] This chapter is based chiefly on Letters to Officers of Ships of War, XX, 6-15; Captains' Letters, CLXVI, 73, 74; CXCIII, 78; Francis Warriner's Cruise of the United States Frigate *Potomac;* and J. N. Reynold's Voyage of the United States Frigate *Potomac.* See also American State Papers, Naval Affairs, IV, 150-158.

[2] Felt, J. B., Annals of Salem, II, 294; Trow, C. E., The Old Shipmasters of Salem, 138-139; Reynolds, J. N., Voyage of the United States Frigate *Potomac,* 201.

Dutch. Quallah Battoo was governed by local rajahs, who were practically independent of their suzerain, the King of Acheen. It contained about 1100 inhabitants, and was defended by several small forts. The Quallah Battooans were described as a treacherous and warlike people, much given to piracy. They were no more crafty, however, than certain American traders, who were wont to use quicksilver in their hollow scale-beams, and who would slip ashore at night and fill up their hollow scale-weights with lead or shot.

Toward the end of the year 1830 Captain Charles M. Endicott arrived at Quallah Battoo in the Salem vessel *Friendship,* and having purchased a considerable quantity of pepper began loading it on board his vessel, a mile or two distant from the weighing place on shore. On the morning of February 7, 1831, Endicott, his second mate, and four of his sailors went ashore to weigh pepper, leaving the first officer and the rest of the crew on board to receive it. Early in the afternoon a boat loaded with pepper and manned by Malays was dispatched to the ship. Instead of proceeding directly to their destination, the treacherous boatmen, in accordance with a prearranged plan, ran their craft into the high grass and exchanged places with a band of armed desperadoes, who on reaching the ship clambered on board and without much difficulty captured it, killing the first officer and two seamen and wounding three others. Four seamen escaped by jumping overboard and swimming ashore.

Meantime Endicott and his party, discovering that the movements of the boatmen were suspicious and suspecting treachery, managed to reach their remaining boat and push off from the landing place before they were attacked by the hostile natives in hot pursuit of them. When half a boat's length from the shore, they were unexpectedly joined by Po Adam, a neighboring rajah of considerable wealth and influence and a friend of the Americans. "What, do you come, too, Adam?" said Endicott. "Yes," was his reply, "if they kill you, they must kill me first, captain." On shore crowds of Malays had assembled, brandishing their weapons; and a ferry-boat, with eight or ten men on board, armed with spears and creeses started in chase of the retreating Americans, who perceiving that they would be overtaken, boldly turned about and pulled toward their antagonists presenting the sword of Adam, their only weapon. This audacious movement so

alarmed the pursuers that they kept their distance and permitted Endicott to escape. When he came in full view of his ship he found the Malays in complete possession of her. As he was practically without weapons, and three native boats were descried pulling toward him, he decided not to undertake the recapture of the ship until he obtained aid. Rowing to the adjacent port of Muckie, 25 miles distant, he found there three American merchantmen, the captains of which on hearing his story agreed to give him their assistance. Accompanied by Endicott, they sailed for Quallah Battoo and on arriving there demanded the peaceful surrender of the *Friendship*. The rajah in authority positively refused to give up his prize, sending word they might take it if they could. On receiving this message the three captains opened fire upon the vessel and the Malay boats that were still carrying away plunder, and were answered by the guns of the vessel and the forts on shore. Finally they sent a boarding party to take possession of the *Friendship,* which it easily did, the Malays deserting her as it approached. She had been plundered of her specie, opium, stores, provisions, nautical instruments, and clothing.

When the news of the outrage on the *Friendship* reached the United States in the summer of 1831, several merchant captains appealed to President Jackson for protection, saying that the conduct of the Sumatrans toward their countrymen was becoming more and more treacherous, that captains and supercargoes were detained on shore and extravagant sums demanded for their ransom, and that during the 40 years that Americans had traded with the island not one of our national vessels had visited it. The President at once decided to send the frigate *Potomac* to Quallah Battoo to obtain redress for the wrongs perpetrated on our citizens.

The *Potomac* at this time was at New York, under orders to convey Martin Van Buren, minister to the court of St. James, to England, and thence proceed to the Pacific station. She was a 44-gun frigate of 1726 tons burden, carrying 400 men. Her commander, Commodore John Downes, had been recently chosen to command the Pacific squadron. He had entered the navy in 1802, had seen important service in the War of 1812 under Commodore Porter during that officer's noted cruise against British whalers, and later had served on both the Mediterranean and Pacific Stations. His tour of duty as commander-in-chief of the

Pacific squadron was his last service at sea. Certain words written by him in 1833, respecting the importance of this squadron have an almost prophetic significance: "Everything conspires to render the Pacific of great interest to the people of the United States at the present time. Our future sea fights are as likely to take place here as on the Atlantic Ocean, for here we are acquiring a preponderating commercial interest, and here must be our navy also." [3]

Downes's instructions from the Department directed him to proceed to the Pacific Station by way of the Cape of Good Hope, Quallah Battoo, Batavia, and Canton. At Quallah Battoo he was to obtain information respecting the attack on the *Friendship,* and, if it agreed substantially with the account received by the Department, he was to demand restitution of the property plundered from the ship, an idemnity for the injury done to her, and the punishment of those concerned in the murder of her crew. Should satisfaction be refused, he was to vindicate our rights by seizing the murderers, retaking the stolen property, and destroying the vessels, forts, and dwellings of the town.

Downes sailed from Sandy Hook on August 26, 1831, and after a passage of 50 days arrived at Rio Janeiro where he took in water and provisions. At the Cape of Good Hope, his next stop, he learned much from the British officers respecting the character of the Quallah Battooans, who were represented as the chief pirates of Sumatra, brave and treacherous men, by no means to be despised as enemies. This information caused him to depart somewhat from his orders, being of the opinion that to carry them out strictly would defeat the main object of the expedition. He decided to make a sudden descent upon the natives, surround their forts, and prevent the flight of the rajahs. He, therefore, approached the town disguised as an East Indiaman, having concealed the guns and closed the ports of his ship. For the events immediately following his arrival the narrative of Francis Warriner, the schoolmaster of the *Potomac,* may be quoted:

> At noon on the fifth instant [February, 1832], we hoisted the Danish national flag, and about two o'clock came to anchor off the town, after a passage of 55 days from the Cape of Good Hope. We came to in merchantman style, a few men being sent aloft, dressed in red and blue flannel shirts, and one top-sail being clewed up and furled at a time. We

[3] Captains' Letters, CLXXXI, 67.

were all anxious to obtain a glimpse of the place and of the adjacent scenery, but no person was allowed to gratify his curiosity in this respect, for fear of disclosing our true character to the natives. Not a single breeze fanned us. Every port being closed, the air that we breathed was close and stifled. The melted tar fell in drops upon the deck, and fairly broiled from the seams between the planks. We were obliged to preserve the stricktest silence, and our situation remained, as it had been for several days, uncomfortable in the extreme.

About four o'clock, Commodore Downes sent a party ashore for the purpose of reconnoitering the place. This party consisted of our first lieutenant, Mr. Shubrick; first lieutenant of marines, Mr. Edson; Lieutenants Pinkham, Hoff, and Ingersoll; acting Sailing-master Totten, and Passed Midshipman Tooley. They left the ship under pretence of contracting for a cargo of pepper. Mr. Shubrick went as captain of the ship, Mr. Edson as supercargo. The remainder in the capacity of common sailors to pull the boat, and they were dressed in a manner conformable to the different characters they assumed. They were obliged to smear their pantaloons with tar, and to stain their hands with rhubarb, that they might resemble old weather-beaten sailors. Their real design was to examine the relative position of the different forts, previous to making the intended attack. When all had approached within a few yards of the beach, they found it lined with a large body of men, exhibiting a warlike appearance, armed with javelins, creeses, cleavers, and sabres, and manifesting very hostile intentions. They, therefore, did not deem it prudent to land. Mr. Shubrick inquired for the rajah. They replied, "He no come down, he be one so great man." Mr. Edson next questioned them as to the price of pepper. They said, eight dollars per picul; but he finally succeeded in inducing them to lower the price to four dollars. A small number were invited to come down to them, and after a consultation was held, about half a dozen approached. Our officers finding that it was their intention to surround the boat, and apprehending some hostile design, pushed farther out to sea. The Malays then exclaimed, "What for you no come ashore?" An excuse was offered, and they were finally told that the next day the captain would come on shore and complete a bargain with them. They inquired with what cargo our ship was freighted and were informed that it was with opium. The gentlemen shortly afterwards returned to the ship, having obtained but an imperfect knowledge of the place, and without ascertaining anything relative to the most advantageous method of assailing the forts.

During the absence of the party ashore, four Malay fishermen, attracted by the sight of an old clump of an Indiaman, as they supposed our ship to be, came alongside to sell their fish. Mr. Barry, who could converse a little in the Malay language, invited them on board. One came up with a couple of fish in his hand, but as soon as he reached the gangway, and saw our formidable battery and about 500 men thickly stowed together, he dropped his fish in the utmost consternation, hurried back to the boat, and gave the alarm to his three companions. They were then told not to be afraid to come on board, that we would buy their fish, and that no harm should befall them. But they were not to be caught in such a

manner. They had no idea of becoming prisoners on board of a ship of war, and began hastily to paddle off. Fearing they might give the alarm on shore, a mizzen-top-man instantly leaped through one of the ports into the boat, and seized them. They set up a yell and made some resistance, but a rope was instantly let down, and they, finding that they were about to be dragged into the ship, *nolens volens,* through one of the ports, thought it policy to submit. As they came over the gangway, they trembled; and lifting their eyes and clasped hand to heaven, like men not knowing where they were, cried aloud, "Allah!" in an imploring tone of voice. They were the poorest, smoke-dried specimens of human nature that we had seen, but perhaps more deserving our commiseration than ridicule. . . . .

"Our ship now presented a busy scene. It was determined to commence an attack upon the town the next morning, and every necessary preparation was accordingly made. Muskets were cleaned, cartridge-boxes buckled on, cutlasses examined and put in order, etc. During the evening, the commodore sent for the officers commanding the several divisions, and gave them their instructions. They were ordered to land, surround the town and forts, and demand indemnity for the outrage committed upon the *Friendship,* with the punishment of those concerned in the barbarous massacre of her crew; but were directed to spare the women and children. I had some conversation with a few of the junior officers, upon the subject of the perilous enterprise in which they were about to embark. They felt that it would not be so much a matter of jest as they had been disposed to think it might be. There was some shrinking at the thought of impending danger. . . . .

At eight bells (12 o'clock at night) all hands were called. Those assigned to take part in the expedition were mustered, when Lieutenant Shubrick, the commander of the detachment, gave them special orders. No man was to utter a word after he had entered the boat; no one was to fire till the command was given; and no man was to desert his ranks. Considerable time was occupied in getting the men into the boats, and in making all things ready. Several of the officers felt impatient at the delay and were fearful that they would be unable to effect a landing in season to surprise the enemy. At length the gallant band, to the number of 282 men—including officers, left the ship about two o'clock.[4]

The landing party was commanded by the first lieutenant of the *Potomac,* Irvine Shubrick, and was divided into four divisions —three of seamen and one of marines. The first division of seamen was commanded by Lieutenant R. R. Pinkham; the second, by Lieutenant Henry Hoff; and the third, by Lieutenant Jonathan Ingersoll. The division of the last named was strengthened by a piece of artillery, a 6-pounder called the Betsey Baker, in command of Sailing-master R. S. Totten. A company of marines, commanded by Lieutenants Alvin Edson and G. H. Terrett, con-

[4] Warriner, Francis. Cruise of the United States Frigate *Potomac,* 77-84.

stituted the fourth division. The capture of a fort was assigned to each division. Mr. John Barry, of Salem, formerly the second officer of the *Friendship,* and now master's mate of the *Potomac,* acted as guide. Commodore Downes remained on board throughout the engagement, taking a station at the larboard gangway, with a spy-glass in his hand. At times, however, he was on the point of running in closer with his ship to aid the landing party. The officers and crew on board took up positions in various quarters, some in the tops, and some hanging upon the shrouds, others in the rigging, and still others on the Jacob's ladder, all "gazing with breathless anxiety." Let us return to Warriner's narrative:

It seems our party had effected a landing near the dawn of day, amid a heavy surf, about a mile and a half to the north of the town, undiscovered by the enemy, and without any serious accident having befallen them; though several of the party were thoroughly drenched by the beating of the surf, and some of their ammunition was injured. The troops were then drawn up in regular order, and under the chief command of Lieutenant Shubrick, took up their line of march against the enemy, over a beach of deep and heavy sand. They had not proceeded far, before they were discovered by a native at a distance, who ran at full speed to give the alarm. The lieutenant ordered his men to quicken their pace, to press onward, and, if possible, to take possession of the forts, ere the enemy should be apprised of the approach. A rapid march soon brought them up with the first fort, when a division of men under the command of Lieutenant Hoff, was detached from the main body, and ordered to surround it. By the time the detachment had reached the rear of the fort, the remainder of the forces had gained its front, and were passing it on their march to assail the other forts, when a shower of balls from some quarter passed over their heads.

The first fort had been found difficult of access, in consequence of a deep hedge of thorn-bushes and brambles with which it was environed. The assault was commenced by the pioneers with their crows and axes, breaking down the gates and forcing a passage. This was attended with some difficulty, and gave the enemy time for preparation. They raised their war-whoop, and resisted most manfully, fighting with spears, sabres, and muskets. They had also a few brass pieces mounted in the fort, but they managed them with so little skill as to produce no effect, for the balls uniformly whizzed over the heads of our men. The resistance of the natives was in vain. The fort was stormed and soon carried; not, however, till almost every individual in it was slain. To'onkou N'Yamat, usually called Po Mahomet, a chief of much distinction among the people, who had been principally concerned in the piratical act of taking the *Friendship,* lost his life at this fort. The mother of Chadoolah, another rajah, was also slain here. Another woman met her death at this fort, but her rank was not ascertained; she fought with the spirit of a desperado.

The sword of war should ever distinguish between armed and unarmed opponents, but if women openly jeopardize their lives in the forefront of battle, can it be expected that they will escape unharmed? A seaman had just scaled one of the ramparts when he was severely wounded by a blow received from a weapon in her hands. But her own life paid the forfeit of her daring, for she was immediately transfixed by a bayonet in the hands of the individual whom she had so severely injured. The seaman's head was wounded by a javelin, his thumb nearly cut off by a sabre, and a ball was shot through his hat. Had it not been for his fortitude and activity, he must inevitably have lost his life.

Lieutenants Edson and Terret, accompanied by a corps of marines, proceeded onward to the rear of the town, without commencing any act of hostility, till they arrived within the neighborhood of the fort which they had been ordered to assail. A bold attack was made upon the fort, and after a spirited resistance on the part of the enemy, it surrendered. Both officers and marines here narrowly escaped with their lives. One of the natives in the fort had trained his piece in such a manner as to rake their whole body, when he was shot down by a marine, while in the very act of applying a match to it. The cannon was afterwards found to have been filled with bullets. This fort, like the former, was environed with thick jungle, and great difficulty had been experienced in entering it. But for their crowbars and axes, the men could not have succeeded. A fire was opened near this fort from a neighboring thicket, upon the marines, by a party of the natives in ambush. It is probable that this was the spot where the unfortunate Brown lost his life. In the vicinity of this fort, Lieutenant Edson found several women and children greatly terrified, and it was with difficulty that he could pacify them. They were carefully conducted to a place of safety, where they remained till the close of the action, when they were humanely released.

The engagement had now become general, and the alarm universal. Men, women, and children were seen flying in every direction, carrying the few articles they were able to seize in the moment of peril, and some of the men were cut down in their flight. Several of the enemy's prows, filled with people, were severely raked by a brisk fire from the 6-pounder, as they were sailing up the river to the south of the town, and numbers of the natives were killed. One of these prows was taken by a party of men belonging to a chief by the name of Po Adam, who resides at Pulo Kio (woody island) on the opposite side of the river. This was the same prow that had been taken from him, a year previous to our arrival, by order of the King of Acheen. Adam is a true friend to the Americans.

A third fort was attacked under the command of Lieutenant Shubrick, assisted by Lieutenant Ingersoll and his division of men, together with acting Sailing-master Totten, in charge of a 6-pounder. Lieutenant Pinkham, being from some cause unable to find the fort he was directed to attack, joined them with his detachment: and the marines, not long after, united in like manner with the main body of the forces. This fort proved the most formidable. It was the largest and the strongest fortified, and the co-operation of the several divisions was ultimately required for its re-

duction; but so spirited was the fire poured into it by our troops that it was soon forced to yield; and the next moment, the American colors were seen triumphantly waving over its battlements. The greater part of the town was reduced to ashes. The bazaar, the principal place of merchandise, and most of the private dwellings were consumed by fire. The triumph had now been completed over the Malays; ample satisfaction had been taken for their outrages committed upon our countrymen, and the bugle sounded the return of the ship's forces; and the embarkation soon after was effected. The action had continued about two hours and a half, and was gallantly sustained by both officers and men from its commencement to its close.[5]

The loss of the Americans in this their first engagement in the Orient was two killed and 11 wounded, among the latter being Lieutenant Edson and Midshipman J. W. Taylor. Shubrick esti mated that the enemy lost at least 150 men killed. Po Mahomet, the principal rajah concerned in the capture of the *Friendship,* was among the dead. Rajah Po Quallan fled at the beginning of the fight and two other rajahs were absent from the town. Most of the captured cannon were spiked and thrown over the parapets. One pair of colors, 26 stands of arms, and one brass field-piece were captured. Among the spoils of war were a Chinese gong, a Koran, and several pieces of rich gold cloth. Many of the men returned laden with rajah's scarfs and shawls, creeses richly hilted and with gold scabbards, gold and silver chuman boxes, pieces of money, ear-rings, finger-rings, anklets, bracelets, and other ornaments. Some of the sailors promised themselves a rich repast upon chickens and ducks, but going on board sooner than they expected they were compelled to leave the captured fowls on shore.

Soon after the return of the landing party, Downes stood towards the town and fired several broadsides into a fort that had been inaccessible to Shubrick, causing it to display a white flag. He next hoisted a white flag on board the *Potomac* as a signal that hostilities had been concluded. Then getting under way he sailed to the neighboring port of Soo-soo where he remained a few days. While lying there he received a flag of truce from Quallah Battoo, the bearer of which informed him that many of the inhabitants had been killed and all their property destroyed. He begged the commodore to grant them peace. Downes replied that he was now satisfied and that peace was granted, but that if they again committed piracy and murder upon American citi-

[5] Warriner, Francis. Cruise of the United States Frigate *Potomac,* 87-91.

zens other ships of war would be sent to inflict further punishment. Alarmed at the fate that had befallen Quallah Battoo, the rajahs of some of the neighboring towns sent delegations to Downes to declare their friendship for him, and to present him with propitiatory gifts of fruits and vegetables. The summary vengeance inflicted by the *Potomac* was long remembered by the natives, and had a most salutary effect. At home Downes was criticised by some of the newspapers for the severity of the chastisement administered to the Quallah Battooans, but not by President Jackson, who approved the course pursued by him.

On February 18 the *Potomac* sailed from Soo-soo for Pangoriang in Bantam Bay on the coast of Java, where a supply of wood and water was obtained. Thence she went to Batavia, from which place Downes proceeded to Buitenzorg to call upon the governor of Java. On the passage to Macao the commodore's secretary died of consumption and was buried at sea. It is worthy of remark as illustrative of the generosity of sailors that the officers and crew of the *Potomac* contributed more than $2000 for the support of the children of the dead man. From Macao some of the officers made an excursion to Canton. Early in June the *Potomac* sailed for the Pacific Station by way of the Sandwich Islands. She finally arrived home in May, 1834, having circumnavigated the globe from west to east, the first American ship of war to accomplish that feat.

VII.

THE EMBASSIES TO COCHIN CHINA, SIAM, AND MUSCAT: 1832-1837.[6]

To make sure that satisfaction would be obtained for the outrage committed on the *Friendship,* the Secretary of the Navy in January, 1832, decided to send a little fleet composed of the sloop of war *Peacock,* Master-Commandant David Geisinger, and the schooner *Boxer,* Lieutenant W. F. Shields, to Quallah Battoo to

[6] The principal sources of information used in writing this chapter are Captains' Letters, December, 1835, 1; August, 1836, 2; Commanders' Letters, U. S. Navy Department Archives, October, 1832, 9; July-December, 1833, 1; January-June, 1834, 108; Letters to Officers of Ships of War, XX, 242, 244; XXI, 421, 507; Roberts, Edmund, Embassy to the Eastern Courts, 5-6, 171-257, 351-363; Foster, J. W., American Diplomacy in the Orient, 45-54; Ruschenberger, W. S. W., A Voyage Round the World, 89-94, 319-320, 340-344.

carry out Commodore Downes's orders in case that officer should fail to do so. From Quallah Battoo, Geisinger was to proceed to Macao and protect our commerce in Chinese waters. On his return voyage he was to visit certain Asiatic and African ports and afford every facility (quoting the words of the Secretary of the Navy) "to Mr. Roberts, the gentleman who acts in the capacity of clerk to the commander of the *Peacock,* to enable him to carry into effect and success his instructions from the State Department." As the chief events of Geisinger's cruise are connected with Roberts's mission a brief account of its origin may be here presented.

Edmund Roberts was a prosperous merchant and ship owner of Portsmouth, New Hampshire. His commercial interests led him to visit the Orient and to study the needs and possibilities of American trade in that part of the globe. Convinced that the establishment of commercial treaties with certain Eastern rulers would prove highly beneficial to his countrymen, he wrote to Levi Woodbury, one of the New Hampshire senators at Washington detailing the neglected state of our trade and showing that the favors granted to Great Britain in the Orient gave that country an advantage over our own. Soon after Woodbury became Secretary of the Navy, Roberts was appointed a special envoy of the State Department and clerk to the commander of the *Peacock,* and was authorized to negotiate treaties with the courts of Cochin China, Siam, and Muscat, placing our commerce on an equality with that of the most favored nations. He was also to visit Japan if he found "the prospect favorable."

David Geisinger, the commander of the *Peacock,* entered the navy as a midshipman in 1809, and became a lieutenant in 1814, a master commandant in 1829, and a captain in 1834. He was one of the officers of the *Wasp* during her notable cruise off the English coast in 1814, and had the good fortune to be sent home in command of the prize *Atalanta,* thus escaping the fate of his shipmates who were lost with their vessel at sea.

In March, 1832, the *Peacock* sailed from Boston for Rio Janeiro, where she expected the *Boxer* to join her. Disappointed in her expectations, she, on June 25, went to sea without her consort, and two months later came to anchor in the Bay of Bencoolen on the west coast of Sumatra. Learning here of the destruction of Quallah Battoo by Commodore Downes, she pro-

ceeded to Lintin by way of Manila. The success of Downes and the satisfactory state of our commerce with China left Geisinger free to pursue the remaining objects of his cruise. Having received on board Mr. John R. Morrison, a son of Dr. Robert Morrison, who was to act as interpreter, translator, and private secretary to the envoy, he sailed from Lintin for Turan Bay, on the east coast of Cochin China, regarded as the best place from which to communicate with Hué, the capital of that country, 50 miles distant. Unfortunately he was prevented from entering the bay by contrary winds and a strong current setting to the eastward. He, therefore, bore away for the port of Vunglam, where he arrived on January 6, 1833, and where he remained more than a month.

From Vunglam, Roberts entered into communication with some minor officials of the Cochin China government, with whom he held numerous parleys and conferences, they at times coming on board and he, accompanied with Geisinger, going ashore. As a preliminary to the opening of negotiations, the officials insisted upon many formalities, more or less insulting to the Americans, to all of which Roberts refused to accede. They asked to see President Jackson's letter to the Emperor, they found fault with Morrison's translation of it, and they objected to the rank of the envoy. On this latter point Roberts succeeded in satisfying them by adding to his title of "special envoy from the United States and a citizen of Portsmouth, New Hampshire," the names of the counties of his State and several of its towns, thereby giving his name a most distinguished and formidable appearance. The principal official remarked that the envoy had more titles than any prince of the empire. Roberts's immediate object was to obtain permission to visit the Emperor or to enter into communication with him and his chief minister. Failing in this, he abandoned his mission to Cochin China.

From Vunglam the *Peacock* sailed for the Gulf of Siam and after a 10 days' voyage arrived at the bar of the Menam River. Communication was at once opened with the King of Siam, who courteously sent three boats to convey the American embassy to Bangkok, the Siamese capital. A party consisting of Geisinger, Roberts, Morrison, and several officers, were thus conveyed to Bangkok, where on their arrival they found a house especially prepared for their accommodation by the king, who also pro-

vided them with a cook, a purveyor, servants, and a superintendent, and feasted and entertained them in a royal manner throughout their stay. As the king was quite willing to treat with the United States, Roberts and the Siamese minister of foreign affairs at once began negotiations and on March 20 completed their labors by signing a treaty of amity and commerce—the first diplomatic instrument executed by the United States and an Asiatic power. It fixed the duties to be paid by American merchantmen on entering Siamese ports, abolished certain barbarous penalties for debts, and provided for the friendly treatment of shipwrecked American sailors.

Shortly before the embassy returned to the *Peacock,* it paid a visit to the king, who received it in accordance with the manners and customs of his court. Of this reception Roberts has left us the following account:

> We entered at length the vestibule through a line of soldiers, and passed to the right of a Chinese screen of painted glass, into the presence of His Majesty. There lay prostrate, or rather on all fours resting on their knees and elbows, with hands united and head bowed low, all the princes and nobility of the land; it was an impressive but an abasing sight, such as no freeman could look on with any other feelings than those of indignation and disgust. We halted in front of the presents which were delivered the day previous, being piles of silks, rich fillagreed silver baskets, elegant gold watches studded with large pearls; they were well disposed to make a show. Having gone through the first ceremony of bowing, we sat down on a carpet; on our being seated the prostrate slaves around us (being the great men of the land) bowed simultaneously three times to the ground, in a slow solemn manner, and we joined in the ceremony as had been previously agreed upon. The king was seated under a canopy, in the Asiatic style, on a cushion of red silk velvet, on the lower and more advanced of the two thrones, which occupied the upper end of the apartment; this was a square seat raised some half dozen feet from the floor. Everything was blazing in gold in and about the two thrones; the larger and unoccupied one was of an hexagonal shape, and resembled a church pulpit, so that the king's person when seated in it, can be visible only through the open spaces, in the form of Gothic windows, about four feet in height by one and a half and two in width. One of these windows is in front, and one on each side of the throne. A pair of curtains of gold cloth formed a partition between him and several individuals of the royal family, who lay crouching just without, on separate carpets, leaving a wide open space between the throne and the two interpreters, who were midway of the hall. Before the curtain and on either side, were eight or ten umbrellas of various sizes; these consist of a series of canopies of eight or ten tiers, decreasing in size upward.
>
> His Majesty is a very stout, fleshy man, apparently about 45 years of

age, of a pleasing countenance. He was dressed in a cloth of gold tissue around the waist, while a mantle was thrown gracefully over the left shoulder. Four noblemen's sons were seated at the base of the throne, at the rear and sides, having long-handled pear-shaped fans, richly gilt, which they kept in constant motion. A few questions were addressed by the king in an audible voice; they were repeated in a lower tone by the phaya phiphat, or second praklang, to the phaya churat, or chief of the Chuliahs, by whom they were whispered to the captain of the port, who interpreted them to us in the same low tone—the answers were returned through the same channels by us—inquiring, in the first place, as to the health of the President and all the great men in our country; our own healths; those of the officers and crew; how long we had been from America; where we had been, and whence bound; desiring me to acquaint the praklang with all my wants, that they might be supplied, etc. The curtain was now drawn and His Majesty disappeared; the court made three solemn kotows, and we our three salams, and then retired.[1]

From Siam the *Peacock* went to Singapore to land Morrison and to obtain supplies, and thence to Batavia, where she was joined by the *Boxer*. After calling at Anjer, the two ships sailed for Mocha, Arabia, in the Red Sea, where they arrived on August 31. Of their visit to this port and their subsequent movements, Captain Geisinger wrote as follows:

I found the place in possession of a Turkish rebel chieftain, named Turkie ben Almas, from Grand Cairo. I was informed he had taken and held this and other places on the eastern side of the Red Sea in the name of the Grand Seignor, but his authority for so doing was not yet recognized by his master. He was formerly an officer in the service of the Pacha of Egypt, and it is quite a doubtful case yet whether he has taken possession of the country for the Sublime Porte, for the Pacha of Egypt or for himself. He evinced a very friendly disposition towards us and the American flag, and expressed high gratification in seeing two American vessels of war in the port, being the first, he was told, that were ever in the Red Sea. In fact it was supposed by the people of Mocha that there were no vessels of that description belonging to our country, or else they would have occasionally visited this and other neighboring places for the protection of our extensive commerce. Our stay at this place was necessarily very limited owing to the near expiration of the southwest monsoon, and, therefore, on the evening of the first of September we sailed for Muscat, the principal place of destination in these seas, and on the 18th of the same month both vessels anchored in the cove of Muscat.

The most friendly disposition was manifested by the Sultan and his officers during our stay, and supplies of wood, water, etc., were furnished gratuitously. We found him very intelligent and affable and greatly beloved by his subjects. Without doubt full reliance may be placed in his faithfully fulfilling his engagements. He now owns eight ships of war,

[1] Roberts, Edmund. Embassy to the Eastern Courts, 256-257.

carrying 22 to 74 guns, and 57 sail of vessels (variously rigged) carrying from four to 18 guns—with a very extensive commerce. The Sultan did us the honor to visit the *Peacock* and was received with the highest honors we were capable of bestowing. He examined every part of the ship and expressed himself in strong terms of admiration at what he considered her fine condition, etc. The Sultan having made several voyages in his own ships of war to his possessions in Africa and elsewhere, is considered to be a good judge of everything relating to naval affairs.[8]

The Sultan of Muscat was a powerful prince who ruled over a large territory extending from the Persian Gulf to the southern limits of Zanzibar. Our merchantmen carried on a considerable trade with his people, the increase and improvement of which was one of the objects of Roberts's embassy. On the day after the arrival of the two ships, Roberts, Geisinger, and Lieutenant Shields had an audience with the Sultan and he readily consented to enter into a treaty with the United States, willingly granting larger concessions than our envoy asked for. By the terms of the treaty signed on September 21, our commerce with his dominions was placed on the same footing as that of the most favored nations, and he promised to support our shipwrecked sailors at his own expense until they found an opportunity to return home.

From Muscat the *Peacock* and *Boxer* sailed for Rio Janeiro, touching on their way at Mozambique and the Cape of Good Hope. As they were to remain on the Brazil Station, Roberts took passage for the United States on the sloop of war *Lexington,* arriving at Boston on April 24, 1834. His treaties with Siam and Muscat were ratified by the President and Senate on June 30, and he was shortly thereafter commissioned to return to those countries and exchange ratifications. He also received orders to make another attempt to negotiate with Cochin China, and to visit Japan and enter into treaty with the ruler of that nation.

To add dignity to the new embassy a little squadron, under the command of a commodore, was placed at the service of the envoy. It consisted of the sloop of war *Peacock,* Commander C. K. Stribling, and the schooner *Enterprise,* Lieutenant A. S. Campbell, both under the command of Commodore E. P. Kennedy, who was authorized by the Department to hoist his broad pennant on board his flagship. Kennedy thus gained the distinction of being the first commander of the "East India squadron."

[8] Masters' Letters, January-June, 1834, 108.

He entered the navy as a midshipman in 1805, and after serving in various stations as a subordinate officer attained the rank of captain in 1828. He died in 1844 while in command of the line of battle ship *Pennsylvania.*

On July 12, 1835, Kennedy sailed with his squadron from Rio Janeiro for Muscat. Three days out of port the *Enterprise,* proving to be a dull sailer, was given orders to part company with the flagship and pursue her own course to the Indian Ocean. The *Peacock* arrived at Zanzibar on September 2. For the stirring events of her cruise during the next few weeks, Kennedy's narrative is the best authority:

The *Enterprise* not having arrived, we sailed from Zanzibar on the 8th September for Muscat; and on the 21st, about two hours after midnight, an almost fatal accident befell the *Peacock* by being stranded near the island of Mazeira, on the desolate coast of Arabia. At meridian on the day previous the ship was found by the chronometers, etc., to be 72 miles to the eastward of that island; and it was intended to preserve that distance from the coast until we should come into the latitude of Cape Ras al Had. But to the violent and uncertain currents on that coast (of which we were ignorant until after the accident), also to the fact that the island is placed on the charts upwards of 30 miles too far to the westward (which has been ascertained by the survey now prosecuting on that coast by order of the British government) must be attributed our misfortune.

After several ineffectual attempts to heave the ship off into deeper water (which failed owing to the anchors breaking and coming home), we became fearful she would be destroyed by the first gale, when no succor could be had short of Muscat, a distance of upwards of 400 miles. The boats, being incapable of saving one-third of the crew, were constantly beset, too, by numerous piratical vessels, who attempted in a most audacious manner to cut off the launch and cutters when carrying out anchors—using also every stratagem to plunder our raft of provisions, etc., and while their number was hourly augmented they clearly manifested the purpose of destroying us and making prize of the ship so soon as they were in sufficient force. Placed in this perilous situation, with very slight hopes of saving the ship, having on board only a small supply of water, in a climate where the sun burns with an intensity which can scarcely be surpassed, I could only look to Muscat for assistance. Being unable to spare either of the large boats, on which rested our only hope of saving the ship and crew, and it being very inconvenient to send a lieutenant on that service, Mr. Roberts, our envoy to Asia, with a promptness and fearlessness which mark all his movements, most kindly volunteered his services to proceed on this most dangerous expedition in an open boat 20 feet in length amidst numerous piratical craft and a boisterous sea, accompanied by Passed Midshipman Wm. R. Taylor and six men. They arrived safely at Muscat in 101 hours, having been pursued by pirates and more than once nearly lost owing to the boat filling with water.

As soon as the situation was made known to the Sultan by Mr. Roberts (with whom he was previously well acquainted) the former forthwith ordered the *Sultana*, a new sloop of war, to be prepared by noon of the following day to proceed to the Gulf of Mazeira with a supply of water and provisions. A courier was likewise dispatched to the Governor of Zoar, a large town near Ras al Had, with orders for him to proceed immediately with six large dows, carring 300 soldiers and a quantity of supplies, to protect the ship and crew until the arrival of the *Sultana*. Having determined to omit no measure which could benefit us, he likewise ordered 350 Bedouins to proceed overland for the protection of the crew in case it became necessary to seek shelter on that most wretched coast. Within one hour and three-quarters from the time of Mr. Roberts's arrival, the ship was preparing for sea, the courier many miles on his way to Zoar, and the Bedouins were in readiness to mount their camels. The *Sultana* sailed at the appointed time, and the next morning we fell in with her about 50 miles from Muscat.

Two days after the boat left us, having lightened the ship by starting three-fourths of our water, everything in the spirit-room, and throwing overboard one-half of our guns, a large quantity of shot, two chain and one hemp cable, rafting sundry barrels of provisions, naval stores and our spare spars (which were finally lost), and striking everything from aloft, we were most fortunately enabled by the great and unceasing efforts and perseverance of the officers and crew, who conducted themselves perfectly to my satisfaction, to heave the ship into deep water, and then to reach Muscat, although in a very leaky condition.

During our stay at Muscat, which was no longer than necessary to complete the business with which Mr. Roberts was entrusted by the Department of State, the Sultan supplied us with large quantities of provisions, vegetables, and fruit, and paid us such personal attention as laid us all under obligations that can never be forgotten. The good Sultan, being still unwearied in his efforts to serve our country through us, dispatched several large boats to Mazeira and saved the 11 pieces of lost cannon. They were carried to Muscat laden on board a baghelo and sent to this place [Bombay], where they have arrived after others had been purchased, but which have been returned to the government from whom they were received. I have made suitable acknowledgement for his truly friendly and unsurpassed promptness in every measure that could benefit us, or contributed to our personal comfort.[9]

On September 30 the ratified treaty was exchanged with the Sultan, and 10 days later Roberts and Kennedy took final leave of that generous ruler. The *Peacock* proceeded to Siam by way of Bombay, Colombo, and Batavia. At Bombay, where she was thoroughly repaired, facilities for such work being freely offered by the officers of the British East India Company, she met the *Enterprise*, and thence the two vessels sailed in company, being

[9] Captains' Letters, December, 1835, 1.

the first American warships to visit British India. Late in March, 1836, they arrived at the mouth of the river Menam, whence Roberts, Kennedy, and several officers went to Bangkok, where they were most courteously received by the Siamese government. The exchange of ratifications was attended with much pomp and ceremony. The delivery of the treaty to the officers appointed to receive it is thus described by the surgeon of the *Peacock,* who witnessed the proceeding:

> Mr. Roberts took the treaty in his hand, and, after holding it up above his head in token of respect, delivered it to a Siamese officer, the secretary of the P'hra Klang. He also held it above his head, and then shaded by a royal chat (a large white silk umbrella) borne by a slave, passed it into the boat, where it was received upon an ornamental stand, and after covering it with a cone of gilt paper, it was placed beneath the canopy. At this moment our band ceased, and that of the Siamese began to play.[10]

The date of the exchange of ratifications was April 14, 1836. Two days before this the commodore was compelled by illness to return to his ship, and soon after the ceremony at Bangkok, Roberts and the rest of the party came on board, all of them unwell and some of them seriously sick, with cholera and dysentery. The squadron next proceeded to Turan Bay, where it remained eight days, at the end of which time, Roberts, having tried in vain to open negotiations with the Emperor of Cochin China and being still sick, abandoned his mission to that country. On May 22 the squadron arrived at Macao, with 61 men sick with cholera and dysentery. Provision for the invalids was made at a temporary hospital on shore, where most of them rapidly recovered. Lieutenant Campbell and Mr. Roberts, however, died, early in June, and they were buried at Macao. The officers of the squadron erected a monument to the memory of Campbell, and the American merchants residing in China contributed the money for a similar memorial to Roberts—the first American diplomat in the Far East.

The visit to Japan was now abandoned. On June 23, 1836, Kennedy sailed from Macao for home by way of the Bonin Islands, Sandwich Islands, and the west coast of North and South America. He arrived at Hampton Roads on October 27, 1837, having been at sea 524 days, and having sailed 54,285 miles.

[10] Ruschenberger, W. S. W. A Voyage Round the World, 319-320.

VIII.

THE CRUISE OF COMMANDER AULICK: 1835-1836.[11]

In the spring of 1834 Secretary of the Navy Levi Woodbury ordered Commodore Alexander Wadsworth, commander of the Pacific squadron, to dispatch one of the sloops of war under his command on a cruise to the Feejee and Pellew Islands, China, and Sumatra. The sloop selected by Wadsworth was the *Vincennes,* Commander John H. Aulick, which vessel, it is recollected, made her first voyage to the Orient in 1829-1830, under the command of Captain Finch.

Aulick entered the navy as a midshipman in 1809, and was promoted to a lieutenantcy in 1814 and a captaincy in 1841. He saw important service in both the War of 1812 and the Mexican War. In the former conflict he served for a time as a junior officer on board the *Enterprise,* displaying much gallantry in that vessel's engagement with the British brig *Boxer.* His work as commander-in-chief of the East India squadron in 1852-1853 will be described in a succeeding chapter.

Aulick's executive officer on the *Vincennes* was Lieutenant John A. Carr. Two of his junior lieutenants were Theodorus Bailey and Samuel P. Lee (a grandson of the Revolutionary statesman, Richard Henry Lee), both of whom fought bravely in the Civil War, and became rear-admirals. Aulick's orders directed him to proceed to the Feejee and Pellew Islands and receive on board his ship any American whalemen or sailors desirous of returning home, to call at Macao and Quallah Battoo for the protection of our commerce, and to make enquiries at all the places visited by him respecting the condition of our trade and the treatment of our citizens. Another particular object of his cruise was the rescuing of the survivors of the New Bedford ship *Mentor,* Captain Edward C. Barnard, which was wrecked on one of the Pellew Islands in May, 1832, situated some 500 miles eastward of the Philippines. About six months after the disaster Barnard and several of his men, accompanied by three natives, went to sea in a whaleboat and a canoe, hoping to reach the Dutch East Indies. The canoe was sunk in a squall and the whaleboat was captured by the natives of Lord North's Island—

[11] The chief sources of information for this chapter are Letters to Officers of Ships of War, XX, 454; XXI, 66; Masters' Letters, January-June, 1836, 5, 54; Niles' Register, XLIV, 421.

a small island lying in the neighborhood of the Moluccas. Here in February, 1833, the captain and one of his men were rescued by the Spanish ship *Sabina,* which carried them to Macao, the rest of the crew of the whaleboat being left behind.

Aulick's eventful cruise began with his leaving Callao on one of the last days of July, 1835, and ended with his arrival at Hampton Roads, a little more than 10 months later, on June 5, 1836. He crossed the Pacific in the latitude of South America instead of making a detour northward to the Sandwich Islands, the course followed by all our naval commanders preceding him. He was also the first to visit the island of Guam, our future possession. Soon after his return to the United States he prepared for the Secretary of the Navy a detailed account of his cruise, which is particularly significant for the information it contains respecting our whaling interests, and for the view it gives of the limited knowledge regarding Oceanica possessed by the civilized world in the first half of the nineteenth century. Aulick's report, in large part, was as follows:

Although my orders from the commodore, directing my return home by way of India, mentioned only the Feejee and Pellew Islands, as those which I was required to visit for specific purposes, the general object of my cruise being as matter of course the protection of our citizens and their interests wherever it might be in my power to afford it, I deemed it my duty, as well from this consideration as with a view to procure as often as possible those refreshments for my crew believed to be essential to the preservation of their health, to touch at such other places on or near my route, as are known to be frequented, for supplies, etc., by our numerous whalers and traders scattered over those seas.

Accordingly on taking my departure from the coast of Peru, I directed my course for the Washington Group, and after a short passage of 19 days, anchored in Massachusetts Bay, Island of Nooaheevah, on the 18th of August. Our reception by the natives was extremely cordial and friendly. The former visit of this ship, and Commodore Porter's long sojourn among them continue to be remembered, and I believe still exercise a favorable influence on their conduct generally towards all foreigners who visit them. They do not, however, appear to have made any progress towards civilization since the commodore left them, or to have risen in any respect above their character and condition at that time, as described in the journal of his cruise. Acts of treachery and savage violence are still occasionally committed on defenceless strangers, and it behooves all such to be constantly on their guard in their intercourse with them, on all parts of the island, but particularly at the Valley of the Typees. From the best information I could obtain there are on an average about 20 American whalers touch here in the course of the year. Water, wood, vegetables, and fruit are readily obtained here for trifles, but hogs are

reserved expressly for the purpose of purchasing muskets and powder; so that I, not being disposed to trade in these articles, was scarcely able to procure one fresh mess for my crew during our stay. But on this point they do not always find their visitors so particular; and I was sorry to learn that, through means of our countrymen chiefly, they were already in possession of a considerable number of arms, and some ammunition.

We sailed thence on the 27th, taking with us two of four American seamen, whom we found there. The other two refused to leave the island. On the 5th September we arrived at Otaheita (Tahiti). This place is much resorted to by our whalers, who find it particularly convenient for refitting and procuring supplies. Some few traders also call here, and, in exchange for various articles of merchandise, get arrow root and cocoa-nut oil, of which, however, owing to the extreme indolence of the natives, but very small quantities are produced for exportation. No public records of any kind, as I was told, are kept by the islanders, nor could I learn from any source the number of American arrivals there annually; but from a memorandum kept by one of the missionary gentlemen, for about six months of the year 1832, it appears that during that period 42 vessels had anchored in Papeete Harbor alone, of which 29 were American, chiefly whalers. Two arrived while we were there, and several others appeared in the offing. Scarcely any depart without leaving some of their crew behind, either from desertion, sickness, or from their being literally turned adrift by the captains. On our arrival I was informed that there was not less than 20 American seamen lounging about the island in a destitute condition. I immediately caused it to be made known that I would give a passage to all who were desirous of returning to their native country; and the Queen Pomare, having expressed to me great anxiety to get rid of all foreigners of this description, I was induced to prolong my stay beyond my original intention in order that those who were at distant villages, might have time to avail themselves of my offer. Eleven got on board before we sailed, and were entered as supernumeraries for rations.

We left Tahiti on the 20th, with Queen Pomare and her family on board, she having requested a passage to the next island to the westward, laying directly in my route; and in the afternoon of the same day we landed her at Eimeo. Thence I pursued my course for the Friendly and Feejee Islands, passing within sight of Whytootacke, one of the Hervey Group, and directly over the place (latitude 19° 7′ south, and longitude 171° 46′ west) assigned to an island on a list of new discoveries in my possession; but no signs of land were visible.

On the 1st of October we arrived at Port Refuge, Vavaoo [one of the Friendly Islands]. In this beautiful harbor we found, to our very agreeable surprise, six American whalers at anchor. Here they ride completely landlocked, secure from the dangers of stormy weather and entirely free from anxiety as to the conduct of the natives, who, though but a few years ago justly ranked among the most savage and treacherous of all the islanders, have now become, as I am well assured, through the persevering exertions of the worthy missionaries residing among them, as honest, amiable, and friendly as those of either the Sandwich or Society

Islands. Our arrival was hailed with much satisfaction by the masters of the whalers, for some of whom it proved to be quite opportune. Most of them had been unsuccessful in whaling. Their men, discouraged and dissatisfied, had become insubordinate, and in one instance actually mutinous to such a degree, that at the request of the captain I took out the ringleaders and confined them in irons on board this ship, until by their, at least apparently, sincere penitence and promise of future good behavior, he was induced to receive them on board again. Two of the vessels had lost a number of their crews by desertion. Their deficiencies I was enabled to supply from our list of supernumeraries, to the satisfaction of all parties.

My principal object in touching at this place was to obtain information, if possible, relative to the navigation of the Feejees, of which I had neither chart nor description that could be of the least service to me as a guide in sailing among them. The account I now received from the missionary residents and native chiefs of both this and of the Feejees (several of the latter being here on a visit), as well as from the captains of the whalers, two of whom had been recently cruising in sight of them, fully confirmed what I had been told at Tahiti and elsewhere, namely: that the group consists of more than a hundred islands, scattered over a space of a thousand miles in circumference; that each island is separately encircled by a reef, and the whole group interspersed with numerous and extensive coral reefs and shoals; that not more than two or three places of anchorage are known, and those could only be reached by intricate passages through the reefs; in short that it was believed to be the most dangerous navigation in the world, and ought not to be attempted by a heavy ship like the *Vincennes,* at least without a small vessel in company to lead the way and examine the ground ahead. The captain of a small English trader that had been wrecked there a few years ago, in a note addressed to me on this subject uses the following language: "I have no hesitation to say it is perhaps the worst navigation in the world; in fact it makes me shudder to think on the narrow escapes I had before losing my vessel, and what I suffered after. Be cautious and do not venture over the ground at night that you have not gone over in the day."

These accounts altogether presented certainly a discouraging picture. Nevertheless had my orders been peremptory on this point, nothing should have prevented at least an effort on my part to comply with them, but such was not the case. They required only that I should "visit the Feejee and Pellew Islands, if practicable without great delay or danger"; thus leaving it at my own discretion and on my own responsibility to act as I might judge proper, of course after obtaining the best information I could on the subject. From the information obtained as above stated, it was evidently not practicable without great danger, and, considering the extent of the group and the great number of islands composing it, it was equally evident to my mind that to pay them such a visit as would be likely to produce good effects, if at all practicable, could not be done without greater delay than our limited quantity of provisions and the other duties yet to be performed before reaching China would warrant. To have simply shown the ship off the islands, without getting near enough

to satisfy the natives of our power to act efficiently against them, if disposed to do so, would only have had a tendency to confirm them in the security of their position, and probably render them still more audacious and dangerous to defenceless traders than they already are. Under all considerations then, I could hardly have felt myself justified in attempting the prosecution of that part of my orders, even had no other motive for its relinquishment existed. But I had other strong inducements for the course I determined to pursue, and which course I hope may meet the approbation of the Department.

I had just learnt from Captain Toby, commander of one of the whalers, that about a year before that time two of the boats of the American whaler *Wm. Penn* had been cut off, and part of their crews murdered by the natives of Oteewhy, or Savie, one of the Navigators Islands. Toby had been there since, had purchased from the chiefs one of the boats, and ransomed some of the men, one of whom made the statement herewith enclosed and numbered "1," from which it appears that no provocation was given by the people of the boats, but that the sole motive for the diabolical outrage was plunder. In addition to this I was informed by several of these captains that an American ship had been seen ashore on one of the Caroline Islands, but a few months before that time. They did not recollect the name of the island, but said they got their information from an American residing at Rotumah, from whom I would be able to obtain the particulars.

Situated, as I now found myself, within three days' sail of Oteewhy, and at no great distance from the Carolines, I felt it incumbent upon me to proceed immediately and endeavor in the first place to punish the wretches who had cut off the boats and rescue the remaining captives; and, when that affair was settled, to hasten to the relief of the ship on shore. Accordingly, having obtained a particular description of the place and of the chief who led the murderous gang, I left Fort Refuge on the 7th in company with all our whalers, and on the 9th had the Navigators in view. The next day being off Oteewhy, and, having masked our ports and otherwise disguised the ship so as to give her as much as possible the appearance of a whaler, we stood close in upon the southwest side of the island where the outrage had been committed; and, as I anticipated, we soon had a canoe alongside, on board which besides eight natives were two Englishmen, who had resided some years on the island and spoke the language fluently. These I immediately pressed into service to act as guides. The natives were brought on board, and the canoe hoisted up to prevent escape. Unfortunately the day was too far gone to admit of our landing an expedition before night, and the landing place was said to be too difficult and dangerous to be attempted in the dark. There being no anchorage here, we stood off and on during the night, and the next morning I despatched Lieutenant Carr with 80 marines and musketeers; and gave him orders to endeavor to capture the chief and as many of his followers as he could, and bring them on board the ship uninjured if possible, to bring off any arms he might find and to set fire to the town and destroy it. In the evening Mr. Carr returned and reported that he landed his party without opposition. He found the town deserted, and destroyed

it as directed, with whatever the houses contained. The natives had fled to the mountains, where they were so thoroughly sheltered by the rocks and underwood that it was not thought advisable to pursue them.

Oteewhy is an island of perhaps 150 miles in circumference, and not under the authority of a single chief, but is divided into several sections, each of which has its separate and independent chief. Aware of this fact, I had charged Mr. Carr to avoid with the utmost care a collision with the neighboring tribes, who the guides told us had no concern in the atrocious act, to endeavor to open a friendly intercourse with some of them and explain the reasons of our descent upon their island, and assure them it was our wish to punish only the guilty. In this he was perfectly successful. A friendly chief, with some of his people, accompanied him on board, and readily admitted to me the justice of the chastisement inflicted on his neighbor, who he said was a very bad man, and he seemed to regret that we had not been able to capture him. Although this expedition did not succeed to the full extent of my wishes, still the display of an armed force upon their shore, to which they did not dare offer resistance, and the destruction of their town and considerable other property, will, I am persuaded, be long remembered by them, and I trust with a good effect on their conduct towards future visitors. The only man (a Sandwich Islander) of the captured boats' crews, that was then on the island, contrived to get off to us, and is now on board this ship. The other boat had been sold to an English whaler but a few weeks before we arrived.

On the 13th we left the Navigators for Rotumah, taking Wallis Island (a favorite refreshing place of the whalers) in our route, and arrived there on the following day. This island is surrounded by a coral reef, within which there is a good harbor. The entrance, however, though deep, is so very narrow that I did not think it prudent to attempt it. We lay off and on two days, during which time we procured some water and a quantity of vegetables and fruit. Two American seamen, who had been left there by whalers, were at their request received on board for a passage home. On the 18th we arrived at Rotumah Island, also much frequented by whalers. One came in at the moment of our anchoring. Much to my regret I was not able to get any satisfactory information here relative to the vessel said to be ashore on one of the Carolines. The man to whom I had been referred perfectly recollected that an English brig had touched at Rotumah a few months before and reported having seen a bright-sided ship ashore on one of those islands, but the name and situation of the place he had entirely forgotten. I was, therefore, compelled to abandon all idea of affording her relief. The anchorage at this island being unsafe, I delayed only long enough to fill up our empty water-tanks.

It was my intention on leaving Rotumah to have held a course as nearly as possible direct for the Pellew Islands, which would have led us through a part of the ocean as yet but little known, and where I was in hopes I might be fortunate enough to make some new discovery. But to my great disappointment we very soon encountered strong westerly winds, which compelled us to stand to the northward, until in spite of ourselves we were carried into the midst of the great chain of the Caroline Islands,

in longitude 167° E. We then had for a number of days a continuation of squally and thick weather, limiting our view of the horizon to so narrow a space, that it became necessary at times, as matter of prudence, to heave to even in the day time, lest we should run upon some one of the numerous islands or shoals, with which that part of the ocean is known to abound. In this situation, and with no time to spare, I thought it advisable to abandon all further attempt to get to the westward in a south latitude. Accordingly we continued on a northern course to gain the strength of the N. E. trade.

In crossing the parallel of the Carolines frequent indications of the vicinity of land were seen, such as green branches of trees and various kinds of land birds: and by our reckoning we must have passed very near several islands, if they were correctly laid down on the charts. We, however, got sight of only one group, consiting of a number of small, low islands and reefs, called " Brown's Range," in latitude 11° 30′ N. and longitude 162° 30′ E. It is said these islands were not inhabited when discovered in 1798. That they now are, there can be little doubt, as we saw a large canoe under sail near the land, and I regretted that the lateness of the hour, it being near night, prevented our communicating with her.

On the 19th November we passed between Rota and Guam (of the Marians) and hove to off Port Apra [Guam] where I had intended to anchor for a day or two, but not liking the appearance of the bar and harbor, I delayed only long enough to get off some fruit and vegetables, after which we continued our route for the Pellew Islands, and on the 26th arrived in sight of them. As this whole group is well known to be almost entirely surrounded by dangerous reefs, and as I had no chart or plan upon which the dangers are described or the anchorage pointed out, prudence required that we should approach them with the greatest caution, and it was not until the 29th that, with one of the principal Rupacks on board as pilot, and an English sailor, who had been many years on the islands, as interpreter, we got to anchor in an open roadstead about eight miles from Corror. We soon received a visit from the king of that island, and were informed that two of the unfortunate *Mentor's* crew were still detained by the King of Baubelthonap, at a place called Arracolon, about 30 miles distant from our anchorage. We also learnt the following particulars on the subject:

When Captain Bernard left these islands after the loss of his ship in 1832, he promised the King of Baubelthonap, into whose hands he had fallen, to return as soon as possible with a certain number of muskets and other articles, which were to be given him as compensation for the maintenance of himself and crew while there, and the aid afforded them in getting away. As security for the faithful execution of this promise, three of his crew were detained by the king, and an equal number of the natives sent with him. At the period of our arrival they knew nothing of the disaster that had befallen the captain and his companions at North Island, and were anxiously looking out for his return. In the meantime one of the men had made his escape in a passing vessel, in consequence of which the other two were the more strictly guarded, and I was assured by the King of Corror (and have since learnt from the men themselves

that such was really the fact) that the chiefs had determined to put them to death rather than suffer them to escape, or give them up until the muskets, etc., were paid, and their own people brought back. Under these circumstances it was not to be expected that they would be peaceably surrendered on my demanding them, particularly as it was well known that the ship could not approach nearer than to within 25 miles of Arracolon, on account of the extensive reefs; and to attempt their rescue by means of a boat expedition would by exasperating the savages undoubtedly put their lives in great peril. This course was, therefore, only to be resorted to as a last alternative. It being already my determination in any event to go to North's Island for the purpose of taking off any that might yet remain of those left there by Captain Bernard, I thought it best to proceed to that place at once, and if possible get off the Pellew-men also, and return to these islands, when I had no doubt our men on Baubelthonap would be readily liberated in exchange for theirs in our hands and thus all difficulty be amicably settled.

On the 9th December, six days from the Pellews, we arrived at North's Island, a low, level, green speck upon the ocean, not above a league in circumference, nor elevated probably more than 20 feet at its highest point, above the surface of the sea. Surrounded by a reef and thickly covered nearly to the water's edge with scarcely anything other than cocoanut trees, on the fruit of which a population of at least 400 human beings depend almost exclusively for both food and drink. We were quickly boarded by a number of canoes, in one of which came one of the Pellew chiefs, from whom we learnt the melancholy fate of the greater portion of his late companions. Of the nine men remaining after the escape of Captain Bernard in 1833, he was now the only survivor on the island. His two countrymen and four of the white men died literally from a want of proper and sufficient sustenance. The other two had got away in a passing vessel. Notwithstanding this statement, the truth of which I could hardly doubt, I determined to examine the island for ourselves. For this purpose the first lieutenant, with a party of 50 officers and men, landed with orders to search it thoroughly and bring off any white men that might be found. His report on returning to the ship confirmed the above account, at least so far that there was not then a white man on the island. Having the Pellew chief on board, we arrived at our former anchorage off Corror on the 16th. The next morning I despatched Mr. Carr for Arracolon, with 120 officers, marines, and musketeers, and two Englishmen as guides and interpreters, directing him to get our countrymen by peaceable means if possible, but to use his arms if he found it necessary.

The King of Corror who had on our first arrival endeavored, I believe from humane motives, to dissuade me from such an expedition, when he saw it on the point of departure, ordered his war canoes, with from four to five hundred men, armed with muskets, spears, clubs, etc., to join us and act under the orders of Mr. Carr; he himself proposing to be my companion on board, if I would permit him, until the return of the boats, thus offering his own person as a pledge that no treachery from his people was to be apprehended. After an absence of nearly four days our boats returned, bringing with them the two seamen (James Meader and Horatio

King) who after much delay and difficulty were at length given up without resort to force, though obviously through the fear of it alone, for they were extremely reluctant to let them go, without the promised muskets, and seemed quite indifferent as to the fate of the chief in our hands. He was of course set at liberty, and some presents of axes, saws, etc., were made them in consideration for what they had done for Captain Bernard, and of their good treatment of the men just released.

Before closing the subject of our visit to these islands, justice requires that I should here mention the attentions we received during our stay from the worthy chief of Corror, commonly called King George, who by his uniform hospitality and kindness to strangers so well sustains the high reputation for those qualities of his ancestor, Abba Thulle. Immediately on our arrival he sent orders to the different towns and villages subject to his authority to send out their canoes and catch fish and to collect fruit and taro for us; and, besides giving us two bullocks (of which there are barely 20 on the islands), we were supplied from day to day with fish, fruit, and vegetables in the greatest abundance for all hands. Everything came in the form of presents from King George. We of course did not fail to make presents in return, which though probably of more value in their estimation than those we received, were still insufficient in ours to cancel the many obligations we felt under to this kind-hearted man.

We sailed from the Pellews on the 20th December and arrived at Lintin on the 2d January, at which time we had less than a fortnight's bread or flour, and barely three weeks' salt provisions on board the ship, from which it will be seen that our hurried movements were not without sufficient cause. Up to that period our crew had enjoyed remarkably good health. We had then only five on the surgeon's report, and those of but slight complaints. But we now very soon felt the effects of the great change of climate to which we were exposed. It was in the midst of the rainy season when we arrived in China and in the course of a few days we had as many as 62 on the sick list, of violent catarrh. In two cases, where the lungs were attacked, it proved fatal. These, with one man lost overboard, as reported in my letter from Lintin, are the only deaths that have occurred amongst us during the cruise. While at Canton I received indirectly from the acting governor of the city the usual orders invariably given to all foreign ships of war that anchor there, namely, to leave the waters of China forthwith and return to my own country. As this was understood to be a mere matter of form and without any other meaning than a simple compliance with "China custom," I took no other notice of it than to request Mr. Wetmore [probably W. S. Wetmore, an American merchant at Canton], the gentleman to whom the note was addressed to say that I intended to go to sea when I was ready. I remained a fortnight afterwards but heard no more on the subject. As it may be satisfactory to the Department to see these curious documents, I herewith enclose translated copies of them, numbered "2" and "3"; with this only remark, that there is not a word of truth in the statement of the "Pilot Tan Ying and others." No enquiries of any kind were ever made of myself or officers, nor am I aware that we were even visited by any of the authorities of the country during our stay.

We left Lintin on the 24th, stopped three days at Singapore, and, passing through the Straits of Malacca, anchored at Quallah Battoo, late in the evening of the 15th February. On the following morning I hoisted a white flag, and fired a salute of nine guns, and immediately afterwards landed, accompanied by a number of the officers of the ship. We were met on the beach by a crowd of armed men, who, though rather curious, conducted themselves in a perfectly respectful manner, and escorted us to the residence of the rajah. Our reception by this personage was polite and apparently friendly. The salute we had fired was now returned with an equal number of guns. I explained to him through an interpreter that I had called by the orders of the government of my country to pay him a friendly visit, and at the same time to see that our countrymen trading on the coast were not again molested in their lawful pursuits. He replied it was very well; he was glad to see me; said he had nothing to do with the affair of the *Friendship;* was not there at the time, nor when the place was attacked; hoped we should remain at peace. I invited him to pay me a visit on board. After hesitating some time, he asked if he could bring some of his friends with him, and being told to bring the whole town if he liked, he accepted the invitation.

Two days afterwards he came agreeably to appointment, accompanied by an escort of about 40 armed men, and bringing with him a couple of young buffaloes and some fruit as a present. I received him with a salute of 11 guns, exercised the crew at quarters, and paid him every other attention in my power. He remained on board several hours, and, when about to leave, requested me to give him a letter to be shown to others who might call there hereafter, certifying in effect that our intercourse had been of the most free and friendly character and that I was satisfied with his conduct. Such a letter was cheerfully given him. I was informed that several of our trading vessels have loaded pepper at this place since the visit of the *Potomac,* and that the trade is now carried on as if nothing had happened. Whatever injury the town may have sustained on the occasion of the attack by that ship, has since been entirely repaired, and I was assured that its defensive works are in a much better condition now, than they were at that time.

We left Quallah Battoo on the 19th, and the same night spoke an American vessel bound there. We anchored for a few days at Cape Town, and also at St. Helena. Our worthy consuls at both those places enjoined it upon me to say to the Department how desirable it was that a ship of war should occasionally pay them a visit. The frequent difficulties occurring among the crews of the different vessels (particularly whalers) that touch at their ports and which it is not always in their power to reconcile in a satisfactory manner, would, they believe, be greatly diminished and the interests of those concerned in the vessels much benefitted by the presence from time to time of a man-of-war. I received on board from the hands of those gentlemen four American seamen who were desirous of a passage home.[12]

[12] Masters' Letters, January-June, 1836, 54.

(TO BE CONTINUED.)

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THE HAVERSINE IN NAUTICAL ASTRONOMY.

By H. B. GOODWIN.

Amongst the more important developments in the accepted methods of nautical astronomy that have taken place in recent years may be mentioned the increased use of formulæ which involve the particular function of the angle known as the "haversine." To the mathematician pure and simple the term is almost unknown, for he is apt to attach no great amount of importance to the practical solution of triangles by means of tables, but in nautical calculations the tabulation of values of the haversine shortens and simplifies the work very materially in the solution of both plane and spherical triangles, and amongst an increasing circle of mariners the haversine methods enjoy a well-deserved popularity. It is the object of this paper to attempt to show how recent improvements in the form of these tables may possibly lead to still further simplification.

First, then, to answer a question with which a certain distinguished "wrangler" from Cambridge astonished a nautical pupil, "What is a haversine?"

The term "haversine" is merely an abbreviation of half versine, the versine being the defect of the cosine from unity.

Thus

$$\text{hav}\, A = \tfrac{1}{2}(1-\cos A) = \sin^2 \frac{A}{2}.$$

Or the haversine of an angle is the square of the sine of half the angle, so that the Haversine Table is sometimes called the "Sine Square" Table.

To appreciate the advantage which such a table affords we have only to write down the formula for a plane triangle,

$$\sin^2 \frac{A}{2} = \frac{(s-b)(s-c)}{bc},$$

or the analogous formula for a spherical triangle,

$$\sin^2 \frac{A}{2} = \frac{\sin(s-b)\sin(s-c)}{\sin b \sin c}.$$

Evidently if a Table of Haversines is employed we shall be saved in the first instance the trouble of dividing the sum of the logarithms by two, and in the second place of multiplying the angle taken from the tables by the same number. This is the special advantage of the form of table first introduced by Professor Inman, of the Portsmouth Royal Naval College, nearly a century ago. So far as nautical astronomy is concerned the use of the Haversine Table has to do chiefly with two cases of spherical-triangle solution:

(a) Given three sides of a triangle to find an angle, the case to which reference is made above.

(b) Given two sides and the angle included, to find the third side.

Under one or other of these heads nearly all the operations which occur in the ordinary daily routine at sea may be said to be comprised.

The second problem has been brought into more than ordinary prominence of late years by the growing favour of the "Marcq" position-lines, upon the principle of calculated altitudes suggested by Admiral Marcq-Saint-Hilaire of the French Navy some thirty-five years ago. It is this method which the ingenious tables of Lieutenant Radler de Aquino, described in a recent number of the PROCEEDINGS, are intended to facilitate.

The principles upon which the Saint-Hilaire process is based were so clearly set forth in the paper above referred to, that we may perhaps confine ourselves here to the solution of the necessary triangle.

Let us suppose that in lat. 43° 20′ N, the declination of the sun being 18° 36′ N, and the hour angle $3^h\ 46^m$ W, it is required to find the zenith distance.

The work will be as follows:

L sine polar distance (71° 24′)	9.97670
L sine colatitude (46° 40′)	9.86176
L hav hour angle ($3^h\ 46^m$)	9.35031
(Sum) L hav θ	9.18877
θ	46° 17′
Natural versine θ	.308907
Natural versine (pol. dist. − colat.) 24°44′	.091735
(Sum) versine zen. dist.	.400642
Zen. dist.	53° 10.5′

This is the working of the problem upon the model that has been followed in the Royal Navy for the last 80 or 90 years. It will be observed that the process consists of two parts; first, the determination by means of logarithmic sines and haversines of an auxiliary angle θ. The value of θ so found is carried as an argument to the Table of Natural Versines, and its versine, added to that of the difference between polar distance and colatitude, gives the versine of the zenith distance required.

Thus three tables in all are required, involving logarithmic sines and haversines, and natural versines. In the year 1905, however, Mr. P. L. Davis, of the British Nautical Almanac Office, published a volume of tables,* in which was included a new and improved Table of Haversines, the use of which would enable the Table of Natural Versines to be eliminated, the number of tables required being thus reduced to two.

The leading feature of this table is that it gives side by side, in parallel columns, the L haversine and Nat haversine, the latter being printed in heavier type than the former. Thus, in the case of the auxiliary angle 46° 17′, as determined above, we find:

Angle.	L Hav.	Nat Hav.
46° 17′	9.18880	.15445

Making use of this improved table we should finish the work thus:

L hav θ	9.18877	Nat hav	.15445
		Nat hav (P. D.−colat.)	.04587
		(Sum) Nat hav Z. D.	.20032
		Z. D. = 53° 10.5′	

Here we have no concern with the numerical value of θ, which has no longer to be carried as an argument to the Table of Natural Versines, and an unnecessary opening of the tables is thereby avoided. The Table of Natural Versines, moreover, becomes redundant, and so obvious are the advantages of the Davis Table that in the latest edition of Inman's Tables, the official text-book used in the Royal Navy, the Table of Natural Versines is omitted altogether, and the combined Table of Logarithmic and Natural Haversines is adopted in its place.

* Requisite Tables. By Percy L. Davis, F. R. A. S. London, J. D. Potter. Price, 10s. 6d.

It has occurred to the writer that the process of amendment might be carried still farther, and that not only the problem worked above, but all the ordinary processes required in every-day nautical astronomy might be dealt with by means of the single improved Haversine Table alone. Such a work as the "Requisite Tables" of Mr. Davis might then be limited to this Haversine Table, which occupies 105 pages, and the remaining 72 pages, which include the logarithms of numbers and of sines, cosines, and tangents, might be dispensed with, in their present form, their place being taken by the Tables of Meridional Parts, Corrections in Altitude, Increase of R. A. of Mean Sun, etc., perhaps some 25 pages in all. The tables omitted would be such as are required only for occasional use, and having no special nautical character, would be found, when wanted, in any general collection of logarithmic and mathematical tables. The advantage of so limiting the size of the volume of tables in daily use will be obvious to all computers.

What then is proposed is briefly this: To obtain a general formula for the spherical triangle, involving only the haversine, and to show how this formula may be adapted to the solution of the following general types:

TYPE I.—Given two sides and the included angle, to find the third side.

TYPE II.—Given three sides to find an angle.

And further, to show how the expressions which result may be applied to the solution of the ordinary practical nautical problems:

(a) Given colatitude, polar distance, hour angle, to find the zenith distance.

(b) Given polar distance, zenith distance observed on a small bearing, and hour angle, to find meridian zenith distance.

(c) Given colatitude, polar distance, and zenith distance, to find hour angle.

(d) Given colatitude, zenith distance, polar distance, to find the azimuth, or true bearing.

(e) Given colatitude and polar distance, to find the amplitude.

To Establish the Necessary General Formula.

In the spherical triangle ABC we have

$$\cos A = \frac{\cos a - \cos b \cos c}{\sin b \sin c}.$$

Therefore

$$1-\cos A=\frac{\sin b\sin c-\cos a+\cos b\cos c}{\sin b\sin c}.$$

Therefore

$$\sin b\sin c\operatorname{vers} A=\cos(b-c)-\cos a.$$

or

$$\sin b\sin c\operatorname{vers} A=\operatorname{vers} a-\operatorname{vers}(b-c).$$

Dividing each side of the equation by two,

$$\begin{aligned}\operatorname{hav} a-\operatorname{hav}(b-c)&=\sin b\sin c\operatorname{hav} A\\&=\tfrac{1}{2}\{\cos(b-c)-\cos(b+c)\}\operatorname{hav} A\\&=\tfrac{1}{2}\{\operatorname{vers}(b+c)-\operatorname{vers}(b-c)\}\operatorname{hav} A\\&=\{\operatorname{hav}(b+c)-\operatorname{hav}(b-c)\}\operatorname{hav} A,\end{aligned}$$

or

$$\operatorname{hav} a=\operatorname{hav}(b-c)+\{\operatorname{hav}(b+c)-\operatorname{hav}(b-c)\}\operatorname{hav} A \quad (1)$$

Here, then, we have an expression containing haversines only, and involving the sides a, b, c with one angle, in this case the angle A.

We will proceed to apply it in the solution of the Types I and II. Since no other function than the haversine is involved, the constant repetition of the word may be avoided, it being understood that:

By $L(\theta)$ is meant L hav θ; i. e., the tabular log haversine of θ.
By $N(\theta)$ is meant N hav θ, or the natural haversine of θ.

TYPE I.—*Given the Sides b, c and the Angle A to Find a.*

In the general formula (1) let

$$\operatorname{hav}\theta=\operatorname{hav}(b+c)-\operatorname{hav}(b-c). \quad (2)$$

Then, substituting in equation (1),

$$\operatorname{hav} a=\operatorname{hav}(b-c)+\operatorname{hav}\theta\operatorname{hav} A. \quad (3)$$

To find θ we have, from (2),

$$N(\theta)=N(b+c)-N(b-c). \quad (4)$$

This determines θ.

Again, let

$$\operatorname{hav}\phi=\operatorname{hav}\theta\operatorname{hav} A$$

in equation (3). Then

$$L(\phi)=L(\theta)+L(A). \quad (5)$$

This determines ϕ.

Thus equation (3) becomes

$$\text{hav}(a) = \text{hav}(b-c) + \text{hav}(\phi),$$

where b, c, ϕ are known, and

$$\text{N}(a) = \text{N}(b-c) + \text{N}(\phi). \tag{6}$$

TYPE II.—*Given Three Sides, to Find an Angle A.*

From the equation (1),

$$\{\text{hav}(b+c) - \text{hav}(b-c)\}\,\text{hav}\,A = \text{hav}\,a - \text{hav}(b-c). \tag{7}$$

Let

$$\text{hav}\,a - \text{hav}(b-c) = \text{hav}\,\theta, \tag{8}$$

$$\text{hav}(b+c) - \text{hav}(b-c) = \text{hav}\,\phi. \tag{9}$$

Then, from equation (8),

$$\text{N}(\theta) = \text{N}(a) - \text{N}(b-c)\,; \tag{10}$$

and from (9),

$$\text{N}(\phi) = \text{N}(b+c) - \text{N}(b-c). \tag{11}$$

These equations determine θ and ϕ, and from equation (7)

$$\text{L}(A) = \text{L}(\theta) - \text{L}(\phi). \tag{12}$$

Application to the Problem: Given Colatitude, Polar Distance and Hour Angle, to Find Zenith Distance.

This is the general problem of the Marcq position-lines, and presents a straightforward example of Type I. The polar distance (p) corresponds to b, colatitude to c, hour angle (h) to A, and zenith distance (z) to a.

The formulæ will be:

$$\text{N}(\theta) = \text{N}(p+c) - \text{N}(p-c),$$
$$\text{L}(\phi) = \text{L}(\theta) + \text{L}(h),$$
$$\text{N}(z) = \text{N}(p-c) + \text{N}(\phi).$$

Application to the Problem of Reduction to Meridian, Approximate Colatitude being Supposed Known.

The formulæ and general procedure will be very much the same as in the preceding problem, except that in the third equation we must transpose z and $p-c$. For one problem is practically the converse of the other. In the first case we know p and c, and have to find z. In the second, z being known we determine an

accurate value of $(p-c)$, which at first is only approximately known. The third equation, therefore, is written in this case

$$N(p-c)=N(z)-N(\phi),$$

the angle ϕ being calculated as before.

Application to the Problem of Finding Hour Angle, Colatitude, Polar Distance, and Zenith Distance being Known.

From the formulæ of Type II,

$$N(\theta)=N(z)-N(p-c),$$
$$N(\phi)=N(p+c)-N(p-c),$$
$$L(h)=L(\theta)-L(\phi).$$

Application to the Altitude Azimuth; Colatitude, Polar Distance and Zenith Distance being Known, to Find the True Bearing (Z).

This again illustrates Type II. For b we have z; for a, the polar distance p is substituted; c represents the colatitude; and for A we have Z.

Then

$$N(\theta)=N(p)-N(z-c),$$
$$N(\phi)=N(z+c)-N(z-c),$$
$$L(Z)=L(\theta)-L(\phi).$$

It is unnecessary, perhaps, to consider in detail the time azimuth, because it is evident that from p, c and h, the data of the problem, we may find z under the formulæ of Type I, and then from p, c and z determine Z by Type II.

Application to the Amplitude.

The interest in this problem, which indeed may be regarded as only a special case of the altitude azimuth, is mainly theoretical, since by means of the Azimuth Tables we may find the compass error with equal accuracy and less trouble at almost any time of day. It is, however, easy to obtain a simple special haversine formula as follows: Let A represent the amplitude.

Since

$$\sin^2 A=\frac{\sin^2 d}{\sin^2 c},$$

we have

$$L(2A)=L(2d)-L(2c).$$

PRACTICAL EXAMPLES.

The following practical examples from Raper's Practice of Navigation (Nineteenth Edition) will serve to illustrate the various processes.

Given Colatitude, Polar Distance, and Hour Angle, to Find Zenith Distance.

Ex. (Raper, p. 238).

$c = 67° 45'$, $p = 92° 49'$, $h = 2^h 14^m 36^s$. Required z.

	N$(p+c)$ 160° 34′	.97151
	N$(p-c)$ 25 4	.04709
(Diff.)	N(θ)	.92442
	L(θ)	9.96586
	L(h) $2^h 14^m 36^s$	8.92315
(Sum)	L(ϕ)	8.88901
	N(ϕ)	.07745
	N$(p-c)$ 25° 4′	.04709
(Sum)	N(z)	.12454
	z	41° 19.7′

Given Polar Distance, Hour Angle, Zenith Distance Near Meridian, and Approximate Colatitude, to Find Reduction to Meridian.

Ex. (Raper, p. 251).

c (approx.) $= 84° 57'$, $p = 73° 45'$, $z = 11° 49'$, $h = 15^m 40^s$.

	N$(p+c)$ 158° 42′	.96585
	N$(p-c)$ 11 12	.00952
(Diff.)	N(θ)	.95633
	L(θ)	9.98060
	L(h) $15^m 40^s$	7.06736
(Sum)	L(ϕ)	7.04796
	N(ϕ)	.00111
	N(z) 11° 49′	.01060
(Diff.)	N$(p-c)$	.00949
	$(p-c)$	11° 11′

Thus the meridian zenith distance is 11° 11′, the reduction being 38′, which is the value obtained by Raper, who makes use of a "second reduction" involving the use of sine and tangent tables, as well as a constant logarithm.

Given Colatitude, Polar Distance, and Zenith Distance, to Find the Hour Angle.

Ex. (Raper, p. 220).

Given $c=38° 50'$, $p=70° 33'$, $z=52° 9'$, to find h.

	$N(z)$	52° 9′	.19320		$N(p+c)$	109° 23′	.66594
	$N(p-c)$	31 43	.07467		$N(p-c)$	31 43	.07467
(Diff.)	$N(\theta)$		.11853	(Diff.)	$N(\phi)$		.59127
	$L(\theta)$		9.07381				
	$L(\phi)$		9.77178				
(Diff.)	$L(h)$		9.30203				
	h		$3^h\ 32^m\ 47^s$				

Given Colatitude, Polar Distance and Zenith Distance, to Find Azimuth.

Ex. (Raper, p. 241).

Given $c=38° 30'$, $p=69° 58'$, $z=49° 35'$ W, to find Z.

	$N(p)$	69° 58′	.32872		$N(z+c)$	88° 5′	.48328
	$N(z-c)$	11 5	.00933		$N(z-c)$	11 5	.00933
(Diff.)	$N(\theta)$		.31939	(Diff.)	$N(\phi)$		.47395
	$L(\theta)$		9.50432				
	$L(\phi)$		9.67572				
(Diff.)	$L(Z)$		9.82860				
	Z		N 110° 21′ W				

Given Colatitude and Polar Distance to Find the Amplitude (A).

Ex. (Raper, p. 327).

$c=73°$, $d=23°$ N. Sun setting.

	$L(2d)$	46°	9.18376
	$L(2c)$	146	9.96119
(Diff.)	$L(2A)$		9.22257
	$2A$		48° 14′
	A		W 24° 7′ N

General Observations upon the Haversine Methods Proposed.

The practice of nautical astronomy, as carried out in the daily routine on board ship at sea, may be broadly defined as the discovery, by means of the observed altitude of some heavenly body, of the coördinates latitude and longitude, which determine the position of a ship, and of the error of the compass by which her course is directed. To these may be added, in the case of disciples of the Saint-Hilaire School, the calculation of an altitude for an assumed latitude and longitude. These problems are solved by different writers in a great variety of ways, involving for each its own particular set of formulæ. The expression made use of for finding hour angle from three sides, for instance, is in general a perfectly different formula from that employed in calculating zenith distance, and the two require entirely independent demonstrations. Under the system outlined above, which I would venture to style the "All-Haversine" System of Nautical Astronomy, we have but to obtain one single general formula, which can be easily adapted to the conditions of the particular case by any one familiar with the elementary properties of logarithms. The necessary course of theoretical study required of nautical students, who are not always overburdened with mathematical knowledge, is somewhat simplified thereby.

In such a subject as this, however, the importance of the theoretical portion is somewhat overshadowed by that of the practical side, so it may be well to consider the matter under this aspect also. Leaving out of consideration the amplitude, which is the subject of special treatment, the four great problems of every-day navigation divide themselves into two groups, according as they come under Type I, which includes the Reduction to Meridian and calculation of Zenith Distance; or under Type II, which involves the calculation of Hour Angle for Longitude, and True Azimuth for Compass Error.

With regard to Type I, the formulæ bring out the fact, which has perhaps not received sufficient attention in the past, that the two problems are essentially similar—and indeed almost one and the same problem. The three equations employed are indeed identical in the two cases, the only point of difference being that if we require zenith distance, as in determining a Marcq position-line we write the third equation

$$N(z) = N(p - c) + N(\phi),$$

while if the meridian zenith distance is required the equation will be set down as

$$N(p-c)=N(z)-N(\phi).$$

In the two cases we obtain our first auxiliary angle θ by a common process from the formula

$$N(\theta)=N(p+c)-N(p-c).$$

This angle is converted into ϕ by the introduction of h in the formula

$$L(\phi)=L(\theta)+L(h),$$

and we have then only to consider whether z or $(p-c)$ is the quantity required, and handle the third equation accordingly.

The two problems, therefore, amount to little more than one, some little discrimination being required at the end of the work, according to the data of the problem.

With regard to the formulæ which come under Type II, where, three sides being given, we have to determine an angle, it may be claimed for the method here suggested that it is at least as short, as simple, as easy to acquire in the first instance, and, when acquired, to retain in the memory, as any process to be found in text-books ancient or modern.

In the case of the hour angle, we have but to subtract $N(p-c)$ first from $N(z)$, and then from $N(p+c)$, to obtain the two auxiliary angles θ and ϕ.

Then from $L(\theta)-L(\phi)$ we have at once $L(h)$, the same openings of the tables which give $N(\theta)$, $N(\phi)$ supplying $L(\theta)$ and $L(\phi)$ without any necessity to take into account the actual values of the auxiliary angles. The same observation applies to the calculation of azimuth, the only point of difference being that z and p are transposed in the latter problem.

An essential feature of the work under either type is the absence of what is known in certain public examinations as "long tots." The operations involved are of the simplest character, never requiring more than the addition or subtraction of two lines of figures. Every computer is aware of the tendency of mistakes to creep in, when the summation of four or five lines has to be effected, as in most of the ordinary methods.

Lastly, with special reference to the particular function of the angle employed, some advantage results from the use of the

haversine, in preference to the more ordinary ratios such as sine, cosine, etc., from the circumstance that the haversine increases continuously from 0° to 180°, and is always positive. It follows from this that the Haversine Table is easier to handle than those which deal with sines and cosines, and we are saved from any risk of taking out L sin 54° from the right-hand column, in lieu of L sin 36°, which should be found in the left-hand column of the page, as is often done by careless computers.

Generally it may be said of the "all-haversine" system here proposed that it demands but one formula, one function of the angle, one Table of Combined Haversines, natural and logarithmic. It was a particularly happy idea of Mr. Davis to combine them in this manner, and a considerable simplification in the calculation of Marcq position-lines has already resulted from the combination. Some day, perhaps, we shall all be enthusiastic followers of the Saint-Hilaire system, but meanwhile there remain a certain percentage who cling to their "Longitude by Chronometer" and "Latitude by Reduction" problems, and it is partly in their interest that the writer has been led to ask permission to set forth these notions, in the hope of further extending the sphere of usefulness of this excellent table.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE PRESENT-DAY PROBLEM OF SHIP PROPULSION

By Lieutenant-Commander L. McNamee, U. S. Navy.

Shipbuilders are proverbially conservative, a trait doubtless acquired from shipmasters, who with lives and property at stake, and frequently far removed from assistance, can least afford to take chances in the way of experiments. This conservatism is especially to be remarked in this country, where the principal plants are maintained largely by contracts for vessels of war, whose design and construction are limited by government specifications that permit little latitude to the contractor in the way of originality or experiment, if he wishes to insure the small profit that will protect the stockholders and keep his yard going. But the world marches, and in the last decade, the restless and constant demand for progress has compelled designers to look about them and take advantage of the strides of invention, necessary to keep pace in the sharp competition of industrial life.

On board ship, the reciprocating engine steadily increasing in expansion and power, from one cylinder to five, finds itself to-day struggling in the last ditch, with its final weapon of forced lubrication, against its stalwart young rival, the modern turbine. The new type, however, has come in spite of a handicap, and one so serious, that the designers of modern turbines are to be sincerely congratulated that they have brought them to a point of superiority to the reciprocating engine. To accomplish this result, it has been necessary to design for speeds within the maximum allowable propeller speed, necessitating a turbine of about five times the weight, with its corresponding complications and loss of economy over the normal design capable of developing the same horsepower. Fig. 1 indicates the size of turbine used to transmit power at 3000 r. p. m.; Fig. 2 at 1500 r. p. m.; and Fig. 3 at 500 r. p. m., illustrating in a striking manner the increase in size

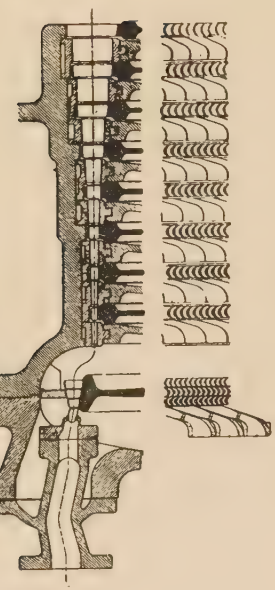

FIG. 2.

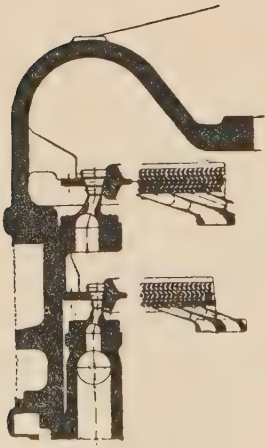

FIG. 1.

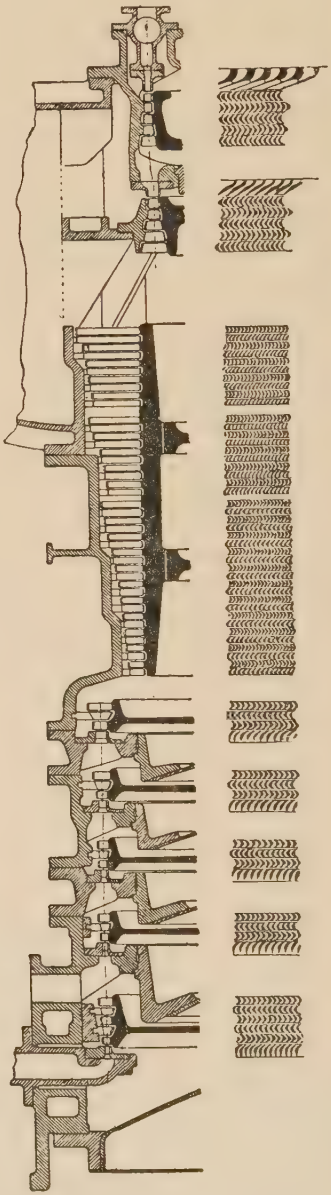

FIG. 3.

and complications necessary to obtain reasonable propeller speeds from a direct connected turbine drive. Fig. 3 shows also the addition of the reversing element.

As an illustration of the lengths to which designers have gone in search of economical turbine operation—the battleship *Wyoming* has an installation requiring 10 turbines and 4 propellers, an arrangement necessary with the type of turbine used, in order to obtain reasonable economies at both cruising and maximum speeds.

It is natural that the engineering world should not be long content with this partial solution of so vital a problem, and this dissatisfaction has manifested itself in some quarters by a return to the reciprocating engine—the obvious desideratum of operating both the turbine and propeller at the most efficient speeds leading to many visionary and half-baked schemes, that have borne only the fruit of doubt and delay.

However, it can now be safely said, that this much desired result is to-day an accomplished fact, with every point of ship propulsion provided for, and one of the largest companies in the country prepared to fully contract for the machinery and guarantee its operation. In other words, there is at hand a ready solution of the problem of ship propulsion, the leading features of which were developed independently to meet the demands of economy in commercial life.

A technical paper entitled, "Application of Electricity to the Propulsion of Naval Vessels," by W. L. R. Emmet, describing this scheme, appeared in the INSTITUTE for March, 1910, under Professional Notes, page 296—the method referred to being described under "Electric Drive" on page 299.

There has been so much comment in and out of the service, and in technical journals, based on misconceptions and misinformation concerning this scheme, that a further examination of its features seems necessary to rescue it from hopeless confusion with other methods that have been suggested to accomplish the same purpose.

The Emmet drive consists briefly of an alternating current generator, driven by a direct connected Curtis turbine, the current being used to drive the propellers through induction motors on the shafts. For a battleship installation requiring 30,000 H. P., two of these turbine alternating current generators of 15,000 H. P.

each, would operate four motors, two on each shaft—one of these to be of simple squirrel-cage type, and the other having resistances connected with the rotor circuit for use in backing. One of the motors on each shaft has a double pole winding, which permits of a change in the speed ratio at a desirable point. Water consumption, or coal consumption (which is the same thing) is thus kept within narrow limits throughout the speed range of the ship, first by use of one generator, with one motor on each shaft, next by increasing speed through changing the number of poles of the motor by means of a switch, and next by two generators operating two motors on each shaft. It must be distinctly understood that there are no abrupt changes in speed, but that the propeller speed for every intermediate number of revolutions is obtained by controlling the speed of the turbine, as is done on the straight turbine drive. The economies shown by exactly similar apparatus built and installed throughout the world, that is, large turbine generators operating motors under the same loads, are fully 40 per cent better than the best straight turbine drive can show at 12 knots speed. The weight of this equipment can be shown to be at least 100 tons less than the design of the straight turbine equipment. The voltage of the driving current would be in the neighborhood of 2000, depending on the speed of the generator at any moment. Objections have been heard to this point, on account of the difficulty of insulation and consequent danger to life. This feature needs some explanation. The armature of the generator is stationary, the rotating field carrying only the exciting current at 125 volts. The entire generator is enclosed, so the current-carrying parts are inaccessible. The cables will be insulated to any desired thickness and carried in armored conduits. All switching is done by insulated levers operating oil switches, with inaccessible current-carrying parts. The motors will be completely enclosed. In short, the installation is designed "fool-proof," interlocking switches rendering an accident through ignorance impossible. The generator circuits are designed to be capable of complete short circuits under full load, without burnout or danger.

Many officers have been misled through unconsciously having in mind direct current apparatus with its commutators and brushes requiring constant attention to guard against sparking, overloads and grounds on circuits extending over the entire ship. No

such troubles are possible in this scheme, and there is no wiring except the straight cable leads to the motors. The revolving field of the generator would be excited from the ship's circuits at 125 volts, with an auxiliary self-exciter on the shaft of the generator to be used when desirable or necessary.

With this arrangement, the actual operation of the sets would reduce itself to the last elements of simplicity, and any intelligent machinist, after a few minutes instruction, could operate the set with perfect confidence and safety. Stopping and backing involves simply the throwing of a switch, and the backing torque developed is greater than that in the design of the straight turbine drive, and would act more quickly. The large currents developed in the rotors of the motors through this sudden reversal, are taken care of by rugged indestructible resistances carried in piping, water-cooled from the main injection. As there are no wearing surfaces involved in this installation, outside of the main bearings of the generating units and motors, the efficiency of the sets would remain practically constant, a condition never attained in reciprocating engines, with their large area of rubbing surfaces affecting friction and leakage of steam.

As motors and generators will be cooled by artificial ventilation, objection has been made that injury might occur from shipping seas through the ventilators in rough weather. It is sufficient answer to such an objection, to state that the entire apparatus could be submerged, and when free from its water, would operate without injury. As the sets would be totally enclosed, and watertight from water in the engine room, and would be warm and ventilated when running, no trouble can be anticipated from dampness.

The operation of induction motors from large generating units belongs to the A B C of electrical installation, and there is no new development involved, the efficiency of the combination is known to every power plant in the world, and it is only a question of time, when its economy will force its use on the most conservative builder.

The combination of turbine generator and motor is simply a speed-reducing bond, comparable to a mechanical gearing, with the important exceptions, that it is an electrical bond permitting wide and variable ratios of speed reduction that enables the turbines to keep near their best efficiency, regardless of the speed of

the propellers, and the elimination of backing turbines, to say nothing of the constant anxiety and watchfulness imposed on the engineer of the watch in transmitting such powers through spur gearing, where the failure of the forced lubrication for a short time might spell disaster. The situation has been summed up by the best engineering opinion as follows:

> If it is possible to devise and construct some form of safety reducing gear, which will be as reliable as the rest of the steamer's machinery, and at the same time will be of such efficiency that the overall efficiency of the plant will be so increased as to more than compensate for the extra capital caused by the upkeep and weight involved, the case of the gear will be made out.

The reliability of electric transmission is beyond question as demonstrated by its universal use under the severest conditions in commercial life. Its efficiency for ship propulsion is greater than either the reciprocating engine or turbine, and there is nothing to compensate for, because it is cheaper to construct, because lighter, cheaper to maintain on account of having no wearing surfaces, except main bearings, and, as stated, of much less weight, amounting at least to 100 tons in a battleship. In other words, the case is made out, not because of statements like the above, but because a contract may now be drawn, guaranteeing every feature of the scheme claimed.

Under these conditions, are we justified in waiting till some more enterprising country points the way?

THE GENIUS OF NAVAL WARFARE.

II.

TACTICS.*

By René Daveluy, Commander, French Navy.

Translated by Philip R. Alger, U. S. Navy.

INTRODUCTION.

Properly speaking, this is not a book of "Tactics"; it is rather a collection of thoughts concerning battle that I have endeavored to deduce from actual occurrences. Yet the title is justified by the fact that tactics is intimately connected with battle, of which it is merely an auxiliary.

This connection has not always existed. There was a period when people fought without other rule than to hurl themselves into the fray and strike out on all sides. Those times have passed: the need was early felt of co-ordinating efforts and of striking truly without ceasing to strike hard. The time for reverting to the heroic traditions of the middle ages does not seem to have come, and we have difficulty in imagining armored squadrons charging the enemy like a troop of bisons.

Nevertheless, many officers contest the utility of a tactics, and their opinion is in part justified by the narrow sense that they attribute to the word. For them, tactics is only a formula or a formation, and they seek in vain for either in our signal code, on the faith of its official title; the efficacy of the evolutions that it contains does not appear clearly, because nowhere is the object to which they conduct pointed out.

A more precise indication can be found in the teachings of the past that we too often neglect to consult. In spite of the profound modifications that naval material has undergone in the course of a century, the lessons of the masters remain our best guide. Every battle is in fact composed of two distinct parts: one moral, the conception; the other material, the execution. If we place our

* Second edition of A Study of Naval Combat.

dependence upon the facts alone, we quickly perceive that their variety brings doubt into the mind and leads to confusion; one would not know how to codify them to form the basis of a doctrine. Moreover, ships of the present time are not limited in their movements as the old ships were, and to seek to imitate the maneuvers of sailing fleets would be steering a wrong course.

But the facts have another bearing: they make known to us the directing thought that gave them birth and reveal to us the reason why of things. Studying them from this point of view, it is seen that the objectives pursued by great leaders have varied little and are independent, to a certain extent, of time and of weapons. The maneuvers of the field of battle had for their object to carry out an idea, generally a very simple one; they were adapted to the means available and to the special conditions of each encounter. Thus it has been possible for battles to wear different aspects without ceasing to be connected by common bonds.

It can, therefore, be said that the conception of battle remains constant throughout the ages, and that the execution yields to the double influence of time and local circumstances.

These considerations point out to us the path that we should follow in this study.

I.

History.

The Tactics of Sailing Fleets.—It was at the battle of the Texel, in 1665, that for the first time a fleet was seen fighting in order. In this battle the English fleet, commanded by the Duke of York, was drawn up in line ahead, close-hauled. This order was at once adopted by naval powers, and took the name "line of battle."

It is known that it owed its origin to solicitude to give the ships a clear field of fire, to preserve them from being raked and to repel the attacks of fire-ships. The line of battle was the initial formation for combat; during the action it was sought to derive from it the greatest possible advantage. Thus there was created, in each navy, a body of doctrines whose principles differed little because they had a common starting-point.

To appreciate at its true value the tactics of the seventeenth century, we must carry ourselves back to the period when it was put in force. Everything then concurred to make fleets unmanageable: they were composed of a great number of vessels;[1] their captains and crews were inexperienced; signals had scarcely begun to be used. With the exception of the Knights of Malta, whom the Order loaned to the King, most of the captains were without knowledge of the sea. As for the crews, it was very difficult to complete them with sailors. Although the system of classes had been in force for several years, it is enough to go a little into the details of history to learn in what a deplorable manner it functioned, especially under Seignelay's administration. The sea-coast population preferred the merchant service to that of the King, who, since Colbert's death, had ceased to pay them. Sailors fled from the conscription, and the first come were put on board to replace them. It may be understood that with such imperfect means admirals could not expect difficult maneuvers from their vessels; their pretensions had to be limited to the execution of a few simple movements. The battle entered upon, the commander-in-chief lost control; the line, extending over a length of several kilometers, was hidden in smoke.

[1] In the reign of Louis XIV squadrons counted from 70 to 100 sails.

Imperfect as this tactics appears to us to-day, it sufficed to its time. Perhaps Tourville, who inspired P. Hoste's *Traité des évolutions navales,* had larger views; perhaps also his ideas were not still more advanced because man instinctively subordinates his aspirations to his means.

Little by little the navy was transformed. In the reign of Louis XV, the naval academy, established at Brest, allowed giving officers the technical instruction that they had lacked till then, while the creation of evolutionary squadrons taught them the practice of maneuvering. At the same time, the multiplicity of theaters of operations, the consequence of colonial development, profoundly modified the composition of squadrons, which now rarely counted more than thirty sails.

For all these reasons, the handling of fleets became easier and permitted a glimpse of more extended horizons. After having submitted to the limitations imposed by a crude implement, the time seemed to have come to employ tactics in a more reasonable manner by not allowing it to fetter ideas. But nothing came of it; lack of initiative and a glorious past preserved to the line ahead the monopoly that it enjoyed. It finally came to be considered indispensable, so true is it that habit warps the judgment and little by little causes the means to be confounded with the end.

Two circumstances, independent of one another, occurred, at twenty years interval, to consecrate this state of affairs.

At the battle of Toulon, February 22, 1744, the English Admiral Matthews attacked the allied fleet before his line of battle was formed. Following this action, the issue of which remained doubtful, Matthews was courtmartialed and dismissed. The grounds of this decision were that he had engaged without forming line of battle. Although Matthews' condemnation was due to other causes than a tactical error, the impression produced upon the minds of officers was not the less profound.[2] It was not till

[2] At the Battle of Minorca (May 18, 1756) Admiral Bing thought of joining the enemy at once; but, mindful of the fate of Admiral Matthews, who had been condemned for having broken his line, he dared not do the same and resigned himself to regulating his speed upon that of his slowest vessels. "You see," said he to Gardner, his fleet captain, "the signal to form line is hoisted, and I cannot, in my capacity as admiral, arrive as if I had but a single vessel to fight. That was the error of Matthews, who should have brought all his ships into action together; I wish to avoid a similar occurrence." *La Marine Française sous le règne de Louis XV,* by Henri Rivière.

long afterwards that English admirals were able to consider themselves freed from the bondage of this judgment; then they learned that they would not be held strictly to account for their maneuvers, provided they were victorious.

In France the order of battle was established by law; it was officially imposed on the navy by the royal ordinance of March 25, 1765. Moreover, an article of the ordinance said, "No captain may leave the line during the action to help a vessel in distress unless signaled by the general to do so." The unfortunate consequences that such a rule might entail will be understood when it is considered that it was materially impossible for a squadron commander to know what was going on at the ends of the line. This article gave the order of battle a rigidity that deprived it of all strength.

In short, the tactics of the eighteenth century was very nearly the same as that of the preceding century. The sole important innovation to be found in it is the introduction of the broadside-to-broadside fighting that resulted in so many indecisive encounters.

When the War of American Independence broke out, the two opposing navies had very nearly identical tactical methods; but the spirit that, in each of them, animated the officers was completely different. The English, emboldened by the successes of the Seven Years War, sought the offensive; the French, on the contrary, still under the influence of their disasters, limited their desires and used all their skill to defeat the attempts of an enterprising enemy. Their constant anxiety was to preserve their material, even when they were superior in numbers. It cannot be denied that our admirals succeeded[3] in an ungrateful task which won them fame as tacticians; but we may regret that they did not employ their talents in attack instead of defence; they would thus have impressed upon their operations a less negative character. Suffren alone, whose genius could not accommodate itself to strict rules, pursued pitilessly the enemy's destruction, and to attain his end attempted to depart from the beaten path of routine; but, misunderstood by his captains, he very soon had to fall back into it, contenting himself with carrying into action an ardor to which our adversaries were not accustomed.

[3] Except at Dominica, where de Grasse presented himself to the enemy with a squadron in disorder.

After ten years of peace, the two navies found themselves again in conflict. In this short interval of time the situations had profoundly altered: on one side, a personnel eager for glory, formed in the school of war, hardened by long cruises; on the other, a material in bad condition, undisciplined crews, captains in whom a certificate of citizenship took the place of knowledge. The issue of the struggle could not be doubtful: the battles of the 13th *Prairial* and Cape Saint Vincent threw a last luster upon the traditional tactics.

It was then that Nelson appeared.

Nelson's military genius was the product of circumstances. Already ripened by a long experience, having given proof of his strength at Saint Vincent and at Aboukir, he receives from Jervis a marvelously trained squadron. Affairs are then in an exceptionally grave position: Napoleon has already stricken from the map of Europe several States, and a single battle lost is sufficient to compromise England's existence. It is under the influence of this situation that Nelson, breaking away from methods which had outlived the necessities that gave them birth, frees himself from the bonds that an outworn tactics puts upon his designs; and, instead of using as best he can the instrument given him by tradition, forges a new one which will be the executer of his thought.

We know what happened.

The overwhelming results of the battle of Trafalgar marked a new era in the tactics of fleets under sail. Nelson, in fact, had put himself in formal opposition to the unalterable principles without which there seemed not to be any safety. For the classic order of battle he substitutes order in columns; he does not hesitate to break his ranks in contempt of all the rules; finally, he attacks the enemy's line at right angles, instead of approaching it by edging up. Thus all the old scaffolding of tactics crumbled in a day, burying our navy under its débris.

Whence came then the impotence of the doctrine that had so long ruled the fleets of Europe? From the fact that it contained two germs of weakness: its starting-point was false, and it was based on a fiction.

Its starting-point was false; for, when one fights, one ought to think of attacking before seeking to defend oneself; and one ought only to defend oneself to an extent that permits the defen-

sive to second the offensive. But the line of battle is a defensive formation; it derives its strength from the mutual assistance that the vessels afford to each other; the necessity of not leaving its position so as not to weaken the line prevents each ship from engaging freely. When the attack was awaited to leeward, the employment of the artillery was dependent upon the will of the enemy, who had to come and put himself in the field of fire of the guns. As for the squadron to windward, it carried its entire line to meet the enemy; but, even in attacking, it counted upon its formation as a defence, so that it assumed the offensive with a defensive weapon, which took away from its action a portion of its efficiency.

The line of battle, it is true, was only a method of beginning the struggle. The incidents of battle always ended by breaking its fine array when the encounter was not limited to a long-range cannonade. It became possible, then, for the one who had best succeeded in maintaining his formation, to bring about a concentration of forces; but parallel lines did not favor it; they lent themselves so ill to enveloping movements that most maneuvers of this sort were scarcely rough-outlined. Here again the strictly defensive character of the line of battle shows itself; for, if concentrations had been the principal objective, the question would have been asked whether the line was the most effective method of preparing them.

These concentrations, moreover, were the privilege of the side having the greater number. Its line then lapped over that of the adversary, and it was possible for it to make, according to the expression of that time, *detachments* upon the ends of the opposing line. The importance of the concentrations was, therefore, a function of the numerical difference of the opposing forces.

Trafalgar revealed the danger of awaiting attack to leeward in extended line; that battle showed, likewise, that attack from to windward, in the same formation, had caused the loss till then of all the benefit given by the offensive.

These deductions could have been foreseen; what prevented them from being apparent was that *the tactics was based on a fiction.*

The course of time had consecrated certain conventional principles;[4] the different phases of an encounter were determined in

[4] Among these we must remember the custom of reserving to the ad-

advance by a tacit understanding, whose terms were faithfully observed for a century and a half. Battle was then no more than a sort of duel in which, by common consent, the adversaries were placed in a given position, after which the struggle was engaged according to the rules of the art.

The proof of how much the tactics then hindered the free play of minds is that in single-ship actions, where its influence did not make itself felt, we almost always had the better of it (at the time of the American War), even against more powerful vessels. The French Navy then had a great nucleus of excellent officers and of trained crews (although often insufficient in numbers); the tactics nullified these elements of success.

Such a method could only give restricted results, and against an adversary himself imbued with the same prejudices. Skilful admirals could derive advantage from it, but its impotency stood out clearly on the day when Nelson, returning to the true concept of war, tore away the veil from the convention.

If we seek to analyze Nelson's mode of action, which was likewise that of Suffren,[5] we observe that it did not have a single point in common with the old ways. His objective is well defined: to destroy the enemy. Every other consideration disappears before that one. To attain this end, the best method is to crush ships with superior forces, to fight two against one. Nelson, therefore, will concentrate his forces upon a fraction of those of his adversary, and he will direct his blows upon the point the most difficult to succor; he will attack the rear. *But instead of waiting,* as till then had been done, *an opportunity to effect a partial concentration during the action, he will know how to impose one of all his forces from the beginning.* These considerations determine his order of battle, or rather the order in which he will lead his vessels onto the field of battle. It will be the order in columns, which gives more flexibility to the fleet and diminishes its depth. As soon as the two columns have approached near enough for the

mirals the honor of engaging one another. Neither did the advantages and inconveniences of the windward and leeward positions have the importance that many have been pleased, with a great abundance of argument, to attribute to them. Never did Nelson or Suffren pay regard to this detail; all positions seemed good to them provided they could join the enemy.

[5] Suffren, less fortunate than his rival in glory, did not have at his disposition the instrument that would have allowed him to realize his conceptions.

rôle of each captain to be clearly indicated, the ranks are broken and each one hastens to his post. The perpendicular attack offered the danger of exposing the heads of columns to raking broadsides to which they could not reply, but it had the advantage of immediately making two breaches in the hostile line and of sowing disorder in it. Nelson, therefore, does not hesitate to adopt it, and he palliates the audacity of his maneuver by taking the head of the first column, while Collingwood directs the second.

Thus, after having fixed upon his object, Nelson regulates his means of action in a fashion to derive advantage from everything that can help him, and he discounts at the same time the unskilfulness of our gunners and the experience of his captains.

We have considered Nelson's maneuver at Trafalgar at such length because it shows better than any reasoning what were the defects of the tactics then in use. It would seem that after so rude a test this tactics should have been abandoned; nevertheless, it survived our disasters and only disappeared with the sailing fleets that had so long suffered from its restrictions.

It was preserved by imputing all our ills to Villeneuve, and the fate of that unhappy admiral contains a lesson that we should ponder.

The crowd is unjust. In ill fortune, it seeks always to heap upon an individual the weight of the errors that have been made, and attributes responsibility to men rather than to the times. Thus it is that Villeneuve has been reproached for incapacity and for his order of battle. Villeneuve was not an incapable. Jurien de la Gravière represents him as "the best-informed officer and the most skilful tactician that the French Navy then possessed." He had discerned with rare sagacity his adversary's plans,[6] but the weakness of his means did not permit him to take another formation than that which was imposed upon him by the regulations.

Before judging Villeneuve, we should put ourselves in his place and recollect that events, fortunate or unfortunate, are less the accomplishment of men than of the ideas they reflect. There

[6] "He (Nelson) will not confine himself," said he to his officers, "to forming line of battle parallel to our own and coming to engage in an artillery contest with us . . . . He will seek to envelope our rear, to break through us, to bring against those of our vessels that he has cut off groups of his to surround them and overcome them" (Jurien de la Gravière).

are few incapable officers; there may be many whose judgment is warped by a defective orientation. Each one participates in the weaknesses of his time; men of genius alone know how to throw them off.[1]

The Tactics of Auxiliary Steam Vessels.—With steam appeared vessels with auxiliary steam power that differed but little from sailing vessels in respect to armament.

The freedom of movement that was the consequence of the use of a motor independent of the wind gave birth to rectangular evolutions; but the order of battle was not modified.

Auxiliary steam vessels not having undergone the test of battle, it is difficult to know the advantage that might have been derived from the new evolutions on the field of action. We will confine ourselves to the statement that their use was limited to the maintenance of a single order of battle, and that they seem to have been conceived particularly with a view to meeting the requirements of cruising.

The Tactics of Rams.—When the cuirass and the ram made their simultaneous appearance, the gun was passing through a period of neglect. Taken unawares by armor plating, it was powerless against the rams that the War of Secession had brought into vogue. The eclipse of the gun could only be momentary: the cuirass has to be spread out, while the gun concentrates its whole force upon a single point. The thickness of the cuirass is, therefore, limited; practically the power of the gun is not, and it is this difference that characterizes in a general way passive defence and attack. The ram, nevertheless, became the principal weapon of ships, and it was necessary to create a tactics appropriate to its use. Then it was that it was agreed to prescribe the line abreast and its derivatives. The order of battle proceeded quite naturally from the application to rams of the same reasoning that was formerly applied to sailing ships: the ram's weapon is its prow; they will, therefore, present themselves bows on to the enemy: its weak point is the flank; they will, therefore, be arranged in the order that will permit them to protect each other, that is side by side. Whence the line abreast.

[1] "I have neither the means nor the time," cried Villeneuve in his discouragement, "to adopt another tactics, with the commanders to whom the ships of the two navies have been entrusted."

Constructed with the same materials as the line ahead that it replaced, the line abreast had the same peculiarity: it was a defensive formation.

By imprisoning each ship between two body guards, its movements were paralyzed and the freedom of motion so necessary for full use of the ram was taken away from it. The attack bows on served much more to protect against blows than to give them; the offensive would have consisted in forcing the enemy to present his broadsides, without which impact is replaced by an ineffective grazing.

That it is necessary to present the bow at the moment of contact, there can be no doubt whatever; but that is not a reason for adopting an extended formation, it is even the best means of depriving oneself of a part of one's rams if the enemy has a more compact front. In fact, when ships are restricted to advancing on the same course and in one line, each ship that attacks finds but a single adversary facing it. The width of the line can, therefore, without disadvantage be diminished in order to increase its depth, which leads to attack in columns. In this manner, several rams are opposed successively to a single one.[8]

Finally, if the columns are brought near to each other, we have Admiral Bouet-Willaumez's naval square, which is essentially favorable to changes of front and can advance upon the enemy's line so as to pierce it at the most suitable point.

The naval square represents not only a concentration of rams in

[8] *With weapons of short range,* a line never covers but a limited space in front of it. If it is desired to make a frontal attack upon it with another line, equal forces can be opposed to it, never superior forces, whether with soldiers armed with guns, with ships armed with cannon or with armored rams. To secure superiority, it is necessary to neglect a part of the hostile line and to employ the forces thus made available to reinforce the others, in a manner to furnish them with a support whose elements take the place of those that fail. This is the arrangement in depth as opposed to that in width. The second is the one instinctively assumed, because, as von der Goltz says, there is an irresistible tendency to extend fronts; the first is that taken by great leaders. Nelson's maneuver at Trafalgar is an arrangement in depth.

Long-range weapons that reach the reserves before they come into action modify their disposition without affecting its principle.

On the sea, with present-day artillery, the deep formation cannot be utilized. It is necessary to seek to obtain in another form the advantages that it gave.

a restricted space, but in itself it exercises a moral pressure on the enemy. The part of the line that is threatened by superior forces tends to hold back from a disastrous shock and to disrupt. The vessels that are about to support alone the weight of the attack seek to shelter themselves behind the others; in this movement they expose themselves and present their broadsides. This formation, therefore, constitutes an offensive order of battle, and if there were to be only one such, it would be much more attractive than the line abreast that seemed to be obligatory. It should be noted that the naval square did not appear in the official tactics. Admiral Bouet-Willaumez doubtless thought it dangerous to expose his plans in advance. He contented himself with introducing it into his battle memorandum.

Oblique movements formed the complement of ramming tactics. Their origin still holds to the principle that one ought to present the bow to the enemy. That is evident; it is not the less so that the ram is a weapon of contact the orientation of which matters little at a distance. If, in order to limit oneself to facing forward, the duration of movements is increased, there is danger of falling into the ranks of the enemy in the act of forming. That is what would have inevitably happened with oblique movements that had the double inconvenience of gaining ground forward and requiring a very long time. One of the indispensable conditions that a battle formation ought to fulfil is to be completed at the moment when there is need of it. Oblique evolutions gave a small chance of realizing this condition and they were more theoretical than practical.

In short, the tactics of rams, although very different in form from the tactics of ships under sail, was the same at bottom. It derived from the same conventional principles; it was based on a defective order of battle.

What will modern tactics be? The introduction of torpedoes into the armament of fighting ships soon brought the ram into discredit. Accidents in cruising proved, moreover, that this weapon was not without danger for the one who used it.

In disappearing, ramming tactics left us a heritage: it bequeathed to us oblique evolutions. But these do not constitute a doctrine.

What then will the tactics of future contests be?

II.

The Object of Battle.

To determine in what way one ought to fight, it is necessary first to specify the object that is sought in fighting.

That object is the destruction of the enemy.

It is not useless, though one might be tempted to think it so, to saturate ourselves with this principle which ought to guide all the actions of our professional lives. It has long been overlooked in the French Navy; it is still so despite the precautions that are taken to hide the true meaning of words under specious theories.

We know that there was a period when armies pretended to wage wars without fighting: battle was not sought, it was submitted to with regret. This period coincided with the War of American Independence, and the false ideas then current had their after effect on the navy. The latter was so much the more disposed to accept them because after the experiences of the inauspicious reign of Louis XV it dreaded to contend with an always victorious adversary.

Since the necessity was not recognized of getting rid of the enemy, of suppressing him, the dominant solicitude was to withdraw from an encounter with the least possible damage. Actions were only half-way entered upon; were fought out of effective range of the guns; then were desisted from without any harm having been done. Apart from the battle of Dominica, there is not a single action of the American War in which a vessel was captured.[9] It was sought before all else to spare the material; that was accomplished, but France let escape the opportunity of a brilliant revenge.

Indecisive battles are fruitless. Historians furnish us with the proof of this when they enter upon long discussions to determine which was the victor; they neglect this demonstration when they speak of Aboukir or Trafalgar.

It would be inexact to assert that all the combats that were not disasters for the vanquished produced no result; but it can be

[9] I speak of squadron actions and not of those between single ships.

maintained that moral victories, which leave the adversary intact, have only consequences of little importance and of little duration. From the fact that the vanquished is left able to reappear on the field of battle, he is given the possibility of reconquering what he has lost and the victor keeps for himself the care of preventing him from doing so. In reading history, we perceive that the fruits of victories would have been multiplied tenfold if, each time that circumstances permitted facing a contest with chances of success, it had been pushed to the extreme limit of human strength.

Here are two examples of this:

In the month of December, 1778, the Count d'Estaing contented himself, in spite of Suffren's observations, with exchanging a few shots with Rear-Admiral Barrington's division, moored at St. Lucia in the bight of Cul-de-sac. The disproportion of forces was immense; the English had only seven ships, we had nineteen. A few days later Byron made his junction with Barrington. If d'Estaing had seriously engaged, he would have destroyed the English squadron and would have remained master of the West Indian seas for a year (see on this subject Suffren's letter to d'Estaing).

In the month of February, 1781, Suffren attacked with twelve ships the English squadron, which was composed of only nine. Deserted by his captains, he was unable to destroy it as he had hoped to do. The result was that the numerical superiority of the French in the East Indies was not maintained, and that in his last action off Cuddalore, in June, 1783, Suffren could only oppose fifteen ships to the eighteen of Admiral Hughes. He was the victor, none the less, but what labors would have been avoided if, two years before, the English had suffered a disaster.

We have chosen these two examples among many because the disproportion of forces made victory the more easy.

Annihilation of the enemy is one of the general laws of war; it derives from the very essence of war, from its definition. It is a necessity that is still more imperative on the sea than on land. On land, the ground plays a part; its possession directly influences operations. One fights to dislodge the enemy, and it may happen that the victor is more used up than the vanquished, because he is forced to expose himself more. On the sea, conditions are different; the field of battle is a common ground that has no value; the

ocean is so vast that one cannot think of taking possession of it, and remains master of it only by suppressing whoever occupies it.

It ought to be superfluous to demonstrate the obligation of destroying the enemy after a century of wars has shown the consequences of battles pushed to the utmost. Nevertheless, the theory of mitigated combat has survived in the French Navy. One does not go so far as to assert that it is necessary to avoid doing harm to the enemy; but, what comes to the same thing, it is currently stated that, in a war in which we shall have inferiority of numbers, we ought to be sparing of material and to keep on the defensive.

To spare material, to keep on the defensive! What do these two expressions mean? It is worth while to come to an understanding on this subject so as not to base a whole system of fighting upon meaningless formulæ.

The advocates of guarding material are obsessed by the numerical insufficiency of our navy. They think that, even as victors, we shall suffer losses that we shall be unable to replace and that it will become impossible to continue the struggle for lack of vessels to carry it on with.

This assertion is not confirmed by facts.

In an action, losses only begin from the moment when one side gives way. So long as victory remains in doubt, it is always difficult to encroach upon an adversary who defends himself vigorously, because his fire protects him. But as soon as the balance inclines to one side, the morale of the vanquished is affected; he no longer resists strongly and soon yields himself without defence to the blows of the victor, who redoubles his efforts. It is then that events thicken and major injuries are inflicted.[10] Thus is explained how it has been possible to win battles at little cost, even with numerical inferiority.

The true protection of material is victory.

If this fact is lost sight of, compensation is sought in the defensive.

[10] The solicitude to refit a vessel after an action in which it has not suffered major damages would be less great if our armament, less various and more simple of operation, was interchangeable. The material ought to conform to the necessities of war, and not to the fantasies of lovers of novelties.

Does it constitute an efficient means of protecting material? What advantages does it procure?

And first, what is the defensive in the matter of tactics?

On land, we easily conceive it. It is easily seen that it is to the interest of an army, in order to compensate for its inferiority, to place itself in a position chosen in advance whence the enemy, arrested by natural obstacles, will not be able to dislodge it without exposing himself. But on the sea, on the common level of the waves, there is no other protection than the artificial one formed by armor plating. But the fighting ship is only a compromise; to increase its protection it will be necessary to melt the steel of the guns to make armor of them. The enemy then benefits by all the shell that are intentionally made a sacrifice of; so that one's material is only spared by sparing that of the enemy to an equal extent. Is that what is asked of the defensive? We do not think so. We believe rather that this word (which expresses an idea and not a fact) is often used from habit without too much understanding of what it means. For the defensive exists, but in a sense quite different from that which is often ascribed to it without defining the advantages that it gives. When a squadron finds itself in a bad position with relation to the enemy, it ought to renounce every enterprise until it has disengaged itself; *it will be on the defensive.*[11] That is a position that is accepted, but is never sought; it always implies a critical situation.[12]

[11] It is in this sense that we shall understand the defensive, when we have occasion to speak of it.

[12] Nevertheless, in sailing fleets, the defensive existed in an advantageous form, though during a very short time. The squadron that received the attack to leeward took a defensive position in the sense that the enemy was obliged, in order to get within range of the guns, to endure raking broadsides to which he could not reply. The defensive resulted from the fact that the enemy was *forced* to expose himself and to pass through a critical moment during which he was inferior. Captain Mahan asserts that the French had the habit, after having submitted to the first onset, of bearing up again and reforming to leeward, in order to induce the assailant several times to renew a dangerous maneuver. In spite of all our admiration for the illustrious American author, we believe this assertion is not justified. Such a procedure is not disclosed either in the reports of the chiefs of squadrons or in the recitals of French historians; it does not seem at any rate to have been established as a system. On the other hand, it would only have had disappointing results, for the lee squadron would have been obliged, in bearing up, to expose itself to raking broadsides from

The defensive is a deceptive word behind which one shelters himself to resolve a problem that seems insoluble: that of numerical inferiority. But we must make up our minds to it and look things in the face; we shall not supplement numbers by hiding our heads so as not to see, as the ostriches do; let us rather count upon the value that we shall know how to give to our personnel.[18]

There are not two ways of fighting, there is only one: it is necessary to seek to destroy the enemy. That is the aim; tactics is the means.

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the stern. The leeward line, moreover, was always enveloped in smoke, and it would have been impossible to make it execute movements whose only value depended on their being made together. We believe that Mr. Lullier, an ex-naval officer, is the only one who has sustained this thesis. It would be ungracious to challenge Mr. Lullier's testimony upon the ground that he has been transported to New Caledonia. His essay on tactics, on the contrary, is very learned; it abounds in original suggestions; but the author was gifted with an unbridled imagination that filled up the vacancies which every recital of a battle inevitably contains when one wishes to find in it arguments to sustain a personal opinion.

[18] To seek to fill the place of military virtues by words is not a wholly modern procedure. In 1794, Jean-Bon Saint-André said in the tribune of the Convention, "Our sailors, disdaining learned evolutions from a spirit of reflection and calculation, would probably judge it more suitable and useful to attempt those boarding contests in which the Frenchman was always victorious and thus to astonish Europe by prodigies of valor." Jean-Bon Saint André knew very well the precarious state of our navy, but he was doubtless ignorant of the fact that it is much more difficult to maneuver for boarding than to keep one's station in a line. After the battle of 13 *Prairial,* he had abandoned his system; but as the line had been very badly maintained by incapable captains, he thought that he would remedy everything again by phrases. He caused it to be decreed "that no captain shall suffer the line to be broken. If the enemy maneuvered to cut it ahead or astern of him, he should maneuver to prevent it, and he should let himself be run foul of rather than suffer it. The captain of a ship at the station of which the line is cut shall be punished with death."

A good captain is worth more than a bad decree.

III.

Armament.

War is a work of destruction. It may be deplored, but it is so. The result is that it is weapons that in the end always have the last word. After having defined the object of battle, we shall now inquire what assistance can rightfully be expected from armament in general and from each arm in particular.

Armament.—The perfection of armament is one of the most important factors of success. Against an adversary who through conservatism has neglected to keep himself abreast of the latest improvements, a superiority of armament is equivalent to numerical superiority.

In general, an old-fashioned material corresponds to a rather low level of moral worth on the part of the personnel; it is only military nations, solicitious of maintaining their rank, that closely follow progress.

To-day, when Europe is the general purveyor of all other countries, so far as weapons of war are concerned, powers of the second rank and semi-civilized nations often possess an armament as perfect as our own; it is even sometimes superior, because rising navies only adopt new material with its latest improvements, while old navies are encumbered with the ancient material that they cannot discard without weakening themselves. The advantage remains none the less with the latter; for it is not enough to have good weapons, it is necessary to know how to use them. Well, there are scarcely four or five countries that are rich enough to keep squadrons constantly fitted out and to take upon themselves the sacrifices necessary for the instruction of the personnel. Moreover, modern arms require such complicated agencies that it is necessary to have the use of special instruments and skilful workmanship to assure their functioning. Without these, all those delicate mechanisms end by going wrong and getting out of order little by little.[14]

[14] The fragility and complication of armament are less the result of the power of weapons than of an error in principle that is the consequence of a long naval peace. When the handling of guns is made dependent upon

The arms used by the principal maritime nations are generally of about the same power. In a period of transformation such as that which we are passing through, there may always come a moment when one country is in advance of the rest; this lead lasts but a short time, and it is rarely so important that armament becomes the arbiter of battles.[15] It is, therefore, prudent not to go asleep in a false security when one is strongly armed.

If there is no very sensible difference between the weapons of maritime nations, the same is not true of the manner of using them that bears the imprint of the character of each people.

Our national genius impels us to seek new means rather than to perfect those that we have. In all epochs it has been so, and this natural tendency of our race makes itself most violently felt each time that we are passing through a critical period, whether from the point of view of organization or from that of number. We seek then an expedient that, at a single blow, may restore the balance in our favor.

The English, on the contrary, make advances more slowly, but more methodically. They have not that flight of imagination that proceeds by leaps and always seeks the elegant solution. They improve what they have slowly, but they take account, to a larger extent than we do, of the conditions of war.

Our intellectual activity is an element of strength on condition that we know how to direct it into the proper channels.

War has exigencies to which all weapons are not fitted to adjust

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the delivery of water under pressure through a long system of piping, and when the light artillery is supplied by electric ammunition hoists that are a marvel of ingenuity, it is not asked whether the breakdowns that occur daily will not take place during action. There is no proof that the same efficiency would not have been obtained with more rudimentary and stronger means, if simplicity had been made an indispensable condition of every military organism. The fact that whenever the excess of this evil has brought about a partial reaction it has not taken long to find a solution, would tend to prove the contrary. It is curious, for example, that hand loading has been returned to in order to obtain a greater rapidity of fire, and that the substitution of a simple gear-wheel for the control-valve of a hydraulic ram has increased the precision of pointing.

[15] It has been said that Sadowa was the triumph of the needle gun. It would be more correct to say that the victory was due to the excellence of the Prussian troops, and that the slight superiority of their armament was only the consequence of a better preparation for war. In 1870 we had a gun superior to that of the Germans; we were beaten, none the less.

themselves to the same degree; their management does not always lend itself to the necessities of the battlefield.

This is a point of view that must be considered and that was neglected when, under the first Republic, the use of hot shot was introduced on board ships. It was thought that a crushing superiority would thus be secured; a system that kept up on board a perpetual focus of fire and was dangerous only to ourselves soon had to be abandoned.

In these days, with torpedo-boats, we have fallen into an excess of a different kind, but having the same origin. People were intoxicated when they saw little vessels that cost scarcely a few hundred thousands of francs carry within them sufficient power to sink an armorclad costing thirty millions. A certain number of officers immediately demanded the suppression of the latter; yet, in the beginning, torpedo-boats were only able to attack within a restricted area and in calm weather. These conditions, which left a large margin for the enterprises of big ships, were of a nature to limit the action of torpedo-boats to special cases, and did not permit their general use. Since then, there has been a recovery from unreasoned infatuation; it is not the less true that these exaggerations have had an unfortunate reaction upon our constructions; and there are actually still not lacking people who imagine that the torpedo-boat, a night bird, will put our coasts out of reach of a day operation, such as a bombardment.[16]

We could easily point out errors of the same sort apropos of submarines.

It is indispensable to regard weapons under two different aspects that bring out clearly their advantages and their disadvantages. The *for* and the *against* are thus determined. The *for* comprises the amount of destructive power and the efficiency; the *against* is represented by the difficulties of execution and of functioning.[17] By applying these elements of appreciation to the various weapons that are in service or have been tried, we learn that weapons are more difficult to manage in proportion as they are more powerful. Thus monster cannon of 100 tons weight

[16] Mobility, that is to say ability to move great distances and in all weathers, is one of the factors of war. Torpedo-boats only possess this quality within a narrow limit and in special weather.

[17] The public, for its part, sees only the favorable side of things. That is the explanation of its not understanding the opposition of technical men to its views.

are terrible engines: a single one of their shell, striking a ship normally at the water-line, may cause her to sink; but the very size of such pieces diminishes their efficiency, because it entails great slowness of fire without increasing the very small chance that a projectile has of striking at an exact point. So the torpedo-boat derives its strength from its speed and its invisibility; but these two qualities render difficult the employment of its sole means of action, the torpedo: the torpedo-boat commander who rushes through the night upon a shapeless mass estimates the distance badly, is ignorant of the speed and often even of the direction of movement of the target that he proposes to strike. If we add to all this the erratic action of the torpedo, we perceive that an aggregate of fortunate circumstances will be necessary in order that a torpedo, launched under such conditions, may attain the mark.

The advantage that can be derived from each instrument of combat will be determined from the data of experience; each of them will then be given a development in proportion to the services that it can render, and will be placed in such a way as to secure its advantages.[18]

Why does the cannon, that ancient instrument, maintain itself in spite of the assaults of more powerful engines? Because it is admirably adapted to the necessities of war. The opposite reason has brought about the disappearance of the fire-ships that had a certain analogy with our first torpedo-boats: on account of their small tonnage, they became a greater and greater embarrassment to fleets in proportion as the latter increased their mobility and radius of action. Moreover, they were only really effective against vessels at anchor, and it was further necessary that the wind should be favorable for their attack. The conditions that permitted bringing fire-ships into the theater of operations, and obtaining favorable circumstances for their use, occurred so rarely that little by little they were given up.

Nevertheless, they never disappeared completely. Instead of being a permanent weapon, as in the seventeenth century, they no

[18] If all new inventions met an established need, few deceptions would be experienced; but it is not at all so: numerous inventors seek to pass off upon us the products of their imaginations without troubling themselves as to the use that can be made of them; it is for us to derive advantage from them as we may. We are here speaking not only of weapons, but of all the mechanisms that gravitate about them.

longer appear except in certain particular operations that afford them special chances of success.[19] It may even be questioned whether it was not the abandonment of fire-ships that permitted bringing them into use again on rare occasions, since their absence from the ordinary composition of squadrons led to the neglect of the very simple precautions that would paralyze their action, and gave the idea of resuscitating a weapon the memory of which was almost effaced.

In fact, when a destructive engine has proved its effectiveness, precautions are taken against the dangers it presents and one often succeeds, if not in rendering it impotent, at least in taking from it the chance of doing harm. The weapon then depreciates little by little and tends to disappear. The fact is thus lost sight of that, even in inaction, it interfered with the enemy's plans by forbidding to him certain operations that only become possible again when it has disappeared. There are weapons that never serve directly: such is the bayonet. Scarcely two or three examples can be cited of troops engaging with the bayonet; generally one side gives way before contact takes place; but that is no reason for doing away with the weapon of assault.

We will sum up this long discourse by saying that it is necessary always to be perfecting one's armament: the sharper an instrument, the better it cuts; but it would be imprudent to count upon a superiority so difficult to secure to the extent of making it the basis of our tactical ideas. If the advantage is in our favor, we shall always profit by it; and the gain that we derive from it will be so much the more considerable that, not having taken account of it in our plans, we shall not have neglected to develop in ourselves the warlike spirit that ought to choose and to direct weapons, and not to let itself be enslaved by them.

This principle will stand out more clearly from the study of different weapons. These weapons are: the gun, the torpedo and the ram.

The Gun.—When an artillery combat is spoken of, what is generally meant is a long-range contest in which the object sought is to put in line the greatest possible number of guns. It is, in fact, a method of utilizing all one's means of action. In this order of ideas the open column, perpendicular to the line that joins the centers of the two forces, is certainly a rational formation.[20] The

[19] The Island of Aix affair; the War of Greek Independence.

[20] *Essai de tactique navale* (Coustolle).

enemy being free to maneuver (since a long distance is maintained) is likewise led to deploy so as to unmask his guns. Thenceforth the combat reduces itself to an intense cannonade; it has thus a great analogy with the actions in two parallel lines that make up nine-tenths of naval chronology. We can, therefore, take them for examples, in spite of the difference of ships and guns, because the relative situation of the combatants remains the same.

This sort of combat has been tested: it is unproductive. Never has the enemy been annihilated when the action has been limited to opposing guns to guns. Fruitful battles have been those in which the symmetry of positions disappeared, and the advantage has not shown itself until this has happened.

This result is easily explained: what is sought, above all, is to secure superiority, and deployment only gives it if numerical superiority is already possessed or if the enemy commits errors, for example if he allows himself to be enfiladed.

If it were necessary to renounce a decisive action, or to resign oneself to be beaten, whenever inferior in number, the prospect would be far from consoling. Fortunately, examples to the contrary authorize us to have higher aims, and other examples show us that, except in special cases where there was an overwhelming disparity of forces, having the most guns is not enough to assure the victory. Number is undoubtedly the most valuable of auxiliaries, but it is not the only one and it is needful to know how to make use of it. The most judicious use that can be made of it consists of deploying all one's means, *while preventing the enemy from doing likewise,* which implies the necessity of imposing one's will upon him. Well, the artillery combat does not permit paralyzing the adversary's movements; it leaves him free to move as he wishes. One can be victor, therefore, only if the enemy contributes to his own loss by the errors he makes. It is a very risky method; not that an error is not possible, but that it is not certain and can quickly be repaired. If it is good to profit by an advantage, it is better to give rise to one.

Modern artillery, with its vast field of fire and its long range, facilitates concentrations. Here there is a new element that will give to combats in parallel lines a character that they did not formerly have. Yet it does not seem that in general any great benefit can be derived from it, since the hostile vessels that are neglected while concentrating one's fire upon others will fire with

so much the more precision as they are the less disturbed. Concentrations of fire used momentarily will help to prepare an ulterior maneuver; this may be an incident of combat, but will not be the combat itself.

Furthermore, a battle is not won without developing to their extreme limit all the factors that assure success in it. In the conflict of artillery, the responsibility rests almost entirely upon the gunners; the command, the influence of which has always been preponderant, plays a part reduced to small importance; the rôle of the captains is insignificant. The tactics of the gun does not suit us, therefore.

This assertion will appear monstrous. I shall be told that it is in flagrant contradiction with facts; that in the latest wars, and particularly in the Russo-Japanese War, the gun did everything; that it is, therefore, the gun that is truly the arbiter of battles.

Such is my real conviction; but in Nelson's time they fought only with the gun. Will it be asserted that Nelson's tactics, which we have already analyzed, was a tactics of the gun? When one has at his disposal but a single weapon, it is with that alone that he will be able to inflict losses upon the enemy; but it does not necessarily follow from this that the command will be guided by the exclusive idea that the gun is its sole means of action.

Doubtless we are no longer in the period of Nelson and one must know how to be of one's own time. I accept this point of view and I take for the basis of discussion the two great battles of the Russo-Japanese War: the battles of August 10 and of Tsushima.

Yes, on the day of August 10 the tactics of the gun did predominate. What a spectacle that combat offers to us! Two parallel lines that exchange shots at very great distances; damages none of which would be sufficient to sink, or even to disable a vessel; killed and wounded so few in number that we have had the right to say that never was battle less sanguinary.[21] Although the Japanese were victors, it was not in consequence of successive advantages gained by mere superiority of gun-fire. Victory declared itself all at once in consequence of the dispersion of the Russian squadron, and at the moment when the Japanese admiral asked himself how the affair was going to turn out.

[21] For the details of this action see *La Lutte pour l'empire de la mer*, Chap. II.

No, it was not the gun that won the victory that day; it was the morale of the Japanese.

Tsushima? It is well known that, at the beginning of this memorable battle, the Russians perceived the Japanese on the port hand, standing to the southwest as though to pass the Russian columns on a parallel course; then all at once the leading vessel was seen to turn to port and the others to follow in succession. If Togo had wished to practice exclusively the tactics of the gun, he would have been obliged to forego this initial maneuver; for, during several minutes, the gun-fire was interfered with and, at the same time, the Japanese vessels had to pass successively through the concentrated fire of the Russians.

Commander Semenoff, in his note-book, remarks that this maneuver caused great surprise on board the *Souvarof* and was taken to augur well for the day. Yet it had a part in giving the Japanese victory since its consequence was the capping of the Russian columns, followed by the immediate putting out of action of their two leading vessels and finally by the throwing into disorder of their ranks. After which, Togo endeavored constantly to outflank the Russian line, the tail of which could not take part in the action on account of its length. That is to say, Togo *deployed all his means while preventing the enemy from doing the same.* The application of this principle has no connection with the nature of the weapons; and the Russo-Japanese War does not modify our opinion as to the insufficiency of the tactics of the gun.

Yet it must be conceded to the latter that it can give victory when one is greatly superior to the adversary in accuracy and rapidity of fire, since by their means double or triple power is secured with an equal number of guns. But generally it is difficult to take into account the enemy's lack of training; since it is only after the battle, and by results attained, that this is ascertained.

The Ram.—The exploits of the ram are sufficiently numerous to allow a determination of the degree of importance that ought to be accorded to combat by ramming.

If we pass in review the battles in which the ram has played a part, we are struck by the fact that, save with very rare exceptions, the attack of rams has succeeded only against vessels at anchor or in a disabled state. Between ships free to maneuver, the game of ramming usually ends in a scraping. To justify this assertion, it is enough to go back to the wars of Secession and of South America, which furnish numerous examples; and to study more

particularly the battle of Mobile Bay and the fight between the *Cochrane* and the *Huascar*.

To study a ramming contest between two vessels, it is customary to take a pair of dividers and to trace the circles in which the ships are made to move. When the two moving points meet at an intersection of circles, the problem is solved.

This whole process goes to pieces before one simple consideration: until the last moment it cannot be told which will be the rammer and which the rammed. All depends on the relative speeds, and each vessel is free to change its own speed at will without the other being able to perceive it.

A commander who has decision and quick judgment will use the ram, if a favorable occasion arises suddenly; but the maneuver could not be made by all the ships of a squadron in common.

Things happened so at a time when one could expect to sink a ship by ramming without being oneself dragged down with her. Recent occurrences prove that actually the rammer runs risks almost as great as the rammed. It is more than ever necessary, therefore, only to use the ram against a stationary ship so as only to strike her with almost no velocity. The ram is an occasional weapon that cannot enter into plans of battle; it is utilized when opportunity offers.

And Lissa? it will be objected.

Is it really true that it was the ram that decided the fate of the action at Lissa?

Let us examine the facts. The Italians lost two vessels: the *Palestro,* set on fire by shell; the *Re d'Italia,* sunk by the *Ferdinand Max*. The ram's contribution to the day's gain was, therefore, only 50 per cent; it was even less, if it is true that the *Re d'Italia* had had her rudder broken by a shot. Yet Tegethoff had made his arrangements and conducted the combat with a view to favoring exclusively the action of the ram; and Persano, furthermore, made his task easy by presenting his broadsides. In spite of all, but a single blow reached its mark; such is the balance sheet of a numerous squadron, led by an energetic chief, in which each did his duty.

Was the victory not rather due to the fact that the Austrian fleet presented itself concentrated before an extended line and pierced it? The Italian squadron, cut in two, had then no other object left but to reunite its fragments; it thus abandoned its principal objective, which was to oppose the enemy, and gave itself

up without defence. Thus the ram, by determining a compact formation, was the indirect cause of the victory; it was not its principal cause. Tegethoff had made it his principal weapon because his guns were powerless against the armor of the Italian ships; but the results were not proportionate to the worth of the Austrian admiral; the weapon was not flexible enough to enable him to use it as he wished. What it is customary to call the tactics of the ram can have nothing to do with the actual collision. It is only in tactical studies that two hostile squadrons advance one against the other in line abreast to fight with the ram. If this ever really happened, it is more than probable that one of the two would maneuver before the collision to escape it. It is thus that things happen in cavalry charges; *never, never* does the collision occur; the less determined turns back the first.

The admiral who shall have the supreme audacity to advance upon the enemy in compact formation will perhaps be thought by posterity to have wished to fight with the ram, when he will only have sought to throw the ranks of his adversary into disorder by forcing him to maneuver under threat of a general collision.

Looked at from this point of view, combat with the ram is a struggle between two characters.

The Torpedo.—Until these latter years, launching tubes being unprotected, torpedoes could be classed in the category of engines that are as dangerous for those who use them as for those against whom they are directed. The introduction of under-water tubes has improved this sorry situation, but it has accentuated a fault that already existed to a less degree; on account of lack of train, a torpedo cannot be launched without exposure to being oneself torpedoed. This outlook is far from attractive. So long as there is no certainty that the enemy is incapable of using his own torpedoes, one will hesitate to use a weapon that enjoys the benefit of reciprocity. The nearer one is to gaining his end, the more willingly will he neglect such a weapon; the moment of winning a victory is not the time to risk losing its fruits.

During the Russo-Japanese War anxiety not to get inside the field of action of torpedoes is evident on both sides; so the torpedo played no part as far as ships were concerned. At Tsushima the Japanese fired some sixty of them, but the distance was too great for them to be able to reach the mark.

This negative result has created in the French Navy a current of opinion favorable to the suppression of torpedoes on battleships.

particularly among the constructors, who are hampered in their plans by the considerable space required for the installation of under-water tubes.

The suppression of torpedoes would be an irreparable error; it would place the French Navy in a state of absolute inferiority as compared with other naval powers.

The torpedo has played no part because each feared to be torpedoed; not to expose oneself to the attack of hostile torpedoes, one had to give up launching one's own. If we Frenchmen shall suppress torpedoes on board our battleships, our adversaries will no longer have to fear being torpedoed; and at the same time they will be in possession of a powerful weapon against which we will remain without defence because we will not be able to reply to its blows. The tactics of the enemy will then consist of bringing his torpedoes into action, and he will do so with so much the less danger that he will not thus deprive himself of his other means. He will endeavor to draw near; and we, not to be torpedoed, will have to withdraw and thereby put ourselves in a bad position. We will find ourselves in the same situation as an army in which the bayonet has been suppressed under pretext that hand-to-hand fighting will never take place.

The suppression of torpedoes would place us under the control of the enemy on the field of battle: the fight would be lost morally before there was any material loss.

And if other navies should kindly deprive themselves of their torpedoes, it would be needful to keep from following their example.

For some years past efforts have been made to increase greatly the radius of action of torpedoes, to which formerly but a secondary importance was attached. It is, therefore, necessary to watch attentively not to be left behind; for a sensible difference in the range of torpedoes favors the one who has the benefit of the greater range because he can hit his adversary without exposing himself to being hit.

Why are our ships not fitted with a bow tube? Firing right ahead permits torpedoing with the least chance of being torpedoed. Broadside torpedoes are defensive weapons that forbid approaching a ship within a fixed limit; the bow torpedo alone is offensive.

IV.

Mass.

Seeking, among the weapons at our disposal, the one that will give us superiority over the enemy, we have renounced the tactics of the gun because it gives no marked advantage, the ram because it is dangerous for those who make use of it, and the torpedo because it is unreliable. We are thus brought to repudiate the system that transforms battle into a methodical contest beginning with the gun, continuing with the torpedo and ending with the ram. Moreover, if we accept this division into sections, we shall run into insurmountable difficulties of execution, since the maneuvers that it would be necessary to make are easier to define than to accomplish. To what extent will ships be in condition to maneuver with the damages that are the consequence of the first phase of the combat (much the longer one)?

These damages will not be negligible, since one is not to pass to the second phase unless the first has been ineffectual, which implies that one has had the worst of it in the artillery combat.

There is here something to make us reflect, and we must drive from our minds the image of a battlefield where maneuvers can be performed as they are on a field of exercise. Let us take care also not to repeat, in the application of this system, the error of the old tactics that never took account of the adversary's movements; for it is evident that this systematic aspect can only be given to battle with the enemy's concurrence.

If we wish to find the true fighting weapon, we must seek it in a study of ancient battlefields and not ask it of speculative theories.

Two conceptions dominate the innumerable battles fought on land and on sea.

The first, which has served as guide in the great majority of encounters, consists in putting in line all the forces available and distributing them uniformly in face of the enemy in such a manner as to produce a balance. This way of acting is natural, one

may even say instinctive; it leads to the line ahead for artillery and to the line abreast for the ram.

At first sight it seems as if it ought to give the most considerable results, since the maximum effort is made everywhere; in practice it gives none, because everywhere the means are insufficient. Numerical superiority, when one possesses it, is equally distributed and does not suffice to assure an appreciable advantage.

The second conception is totally different; it has only been put into effect by the masters of the art of war. For them the object is not to utilize forces in a reasoned-out fashion, and to give them a systematic distribution that ought to meet all possible eventualities; their object is to make use of material forces to shatter the moral force of the enemy and to profit by his moral depression to strike decisive blows.

Thus battle is no longer subjected to the application of fixed rules; it takes the turn that is impressed upon it by a controlling idea which varies according to the circumstances, because it draws inspiration solely from the situation. The method is the same on land as on the sea; and, to characterize it, we will cite an example that appears to us to illustrate it particularly well.

On June 14, 1807, Napoleon encountered the Russians at Friedland. The hostile army was deployed along the Alle, with the river at its back; four bridges secured its line of retreat and put it in communication through Friedland with its reserves, which remained on the other side. From the plateau of Posthnen, the Emperor sees the situation and immediately he no longer has but one idea, a single one: to seize hold of the bridges. He then forms a column which he puts under Ney's orders, and he launches it to the assault of the bridges. For all else he has no thought or care; Oudinot, whose grenadiers are with difficulty holding in check the line of hostile skirmishers, sends officer after officer to him seeking reinforcement; he pays no attention. Why? Because he knows that the crux of the situation is solely at Friedland and that from the instant that the Russians are cut off from the town they will give up; and the event proves that he was right.

In all Napoleon's maneuvers we find this same solicitude to put pressure on the enemy's morale rather than to fight him methodically; and as his thought is always correct he is always victorious.

When conditions do not favor this tactics, the struggle is longer, more bitter; it is, above all, more sanguinary.

On the sea, where the arena does not offer the same resources as on land, the psychological side of battles is less apparent; it exists, none the less. The efficacy of the maneuver that consisted in cutting the line derived much more from moral than from material causes. Ships, quite like men, have need while they fight of feeling themselves supported. Breaking the line destroyed cohesion in the squadron; the ships, instead of clinging to a hostile ship to fight broadside to broadside with her, were dominated by anxiety to renew the bond that had just been broken, even if—what was still more serious—they did not consider the game to be definitely lost. In either case the enemy took advantage of it to concentrate upon one of the segments of the line, which succumbed under the weight of superior forces.

Nelson's maneuver at Aboukir and at Trafalgar did not have for its only consequence the production of an irresistible material effect; the moral effect appears clearly in the evasions of Decrès and of Dumanoir, who hesitate so much that they remain outside the action.

It will be said that all this is very possible, but that times have changed. To-day there can be no cutting the line nor any attack upon one of its extremities that depends for its success upon the difficulties of maneuvering under sail. Evidently we do not clearly discern what can be done because war is an art and inspiration comes only to the artist. We must not draw the conclusion that nothing can be done. If everybody had had the idea of the Austerlitz maneuver, it would have been ineffective and nothing would differentiate Napoleon from the most obscure of his generals. Moreover, it would be difficult to specify; since there are as many particular cases as battles, and each time the data vary. We can, therefore, only lay down guiding principles the application of which will vary according to the special circumstances at each encounter.

These principles can be summed up as follows:

To destroy the enemy's cohesion, to demoralize him, to incite him to give up the struggle by abandoning the stakes: such is the aim.

To realize these different objectives there is needed an instru-

ment of irresistible strength, certain in its action. It is mass or concentration of forces.[22]

This is the arm of victory.

Materially, mass annihilates every defense at the place where it is brought to bear; morally, it takes away from those who support its weight every chance of resisting; well, troops that fight without hope defend themselves badly.

It does not act without method; it utilizes all the elements of which it is made up for the best interests of the moment, taking advantage of all the opportunities that are born of circumstances, by bringing into action all its weapons according to the immediate needs. It does not detract at all from the importance of armament since it derives its strength from the accumulation of a great number of weapons at a single point.

Variable in its form, mass adapts itself to all combinations, and it is this that makes it the arbiter of battles; however powerful a weapon may be, its efficiency is limited; when all one's guns have been put in line, the maximum of what they can give will have been attained; man's intelligence, on the contrary, has inexhaustible resources, and mass is the sole weapon that he can dominate.

To subordinate tactics to the logical employment of weapons is to confine it to a rigid formula that the enemy can use with as much success as we; well, battles are not won by formulæ, but by great captains.[23]

Therefore, let us profit from the lessons given us by men who knew war better than we do; let us remember that the tactics of weapons ought to be subordinated to the tactics of masses.[24]

[22] It is necessary to establish henceforth a distinction between a concentration of forces and a concentration of fire. A concentration of fire only becomes a concentration of forces in the case when the portion of the hostile forces that is neglected can take no part in the action. Then there results a superiority that otherwise would be doubtful.

[23] The difference of the two methods is easy to perceive. In the former, one fights so as to utilize his weapons; in the latter, one utilizes his weapons so as to fight. In the one, it is sought, above all, to have everything properly in order; the formation is independent of the enemy. In the other, the dominant solicitude is thirst to destroy the enemy and the means of succeeding in doing so.

[24] Nelson fought three great battles: Aboukir, Copenhagen and Trafalgar. At Copenhagen alone the local conditions did not allow him to bring about

a concentration of forces; so, by his own avowal, that battle was the most murderous of the three, and he got out of it only by the help of a hardly honorable expedient.

During the whole period of the wars of the Revolution and Empire, the English were greatly superior to us in gunnery. The abstract of losses, drawn up by Commander Chevalier, shows an enormous disproportion. Despite the initial advantage that thereby accrued to the English, Nelson did not think he ought to oppose ship to ship. There is here an indication that should not be overlooked. It brings out the fact that, to reduce a ship, there are needed first means proportionate to her defensive strength; then, if this ship defends itself with its offensive weapons, other supplementary means must be added; that is, there must be numerical superiority. When there is equality in other respects (as in single-ship actions) victory depends on moral factors.

V.

Battle Range.

Before going further, we must elucidate a question that would be constantly arising if we did not settle it at the start: What is battle range?

The preceding considerations furnish us with the answer.

We can deduce from what has been said that the gun is a permanent weapon, while the ram and the torpedo are only occasional weapons. The gun will, therefore, fix the range within the zone in which distance affords protection from the accidental hit of a torpedo. With this reservation, the range regulates itself—it should be that which will permit reducing the enemy most rapidly by giving the artillery its maximum efficiency.

Heaven defend us from here entering into the domain of the gunnery officer; but we do not think we are departing from a wise reticence in affirming that, at very great ranges, the regulation of gun fire is a problem that does not admit of an absolute solution, especially under the conditions which will surround it on the field of battle. The object sought in requiring the guns to fire at the target at great distances is to secure an initial superiority, and that is right. By laboring to solve this difficult problem in the most satisfactory manner, the gunners perform their part in the common work; but the general law of battle is not thereby altered. The commander, in fact, does not have to concern himself with methods of firing; he has only to observe its effects and weigh its results. He looks, therefore, and he sees that, everything else being equal, the number of hits diminishes as the distance increases. Since what is wanted is to subjugate the enemy, he is inevitably led to adopt the range at which there will be the least possible number of shots thrown away. The sole anxiety of the commander will be to place himself, in relation to the aggregate of hostile forces, in such a position that, having a great superiority of fire over one part of the enemy's ships, he may be sheltered from the fire of the rest. Accuracy of fire will be none the less valuable; during the period of approach it will occasion damages

from which a lasting advantage will be derived; throughout the action it will make itself felt continuously, and in proportion as the range diminishes will permit specifying the objects to be aimed at on each ship. To increase the distance with the idea of profiting by a better firing method would be making the fate of the battle depend upon a doubtful speculation; in any event, it would be taking one advantage at the cost of another of greater value that consists of not wasting one's ammunition. It is not a question of exhibiting the skill of our gunners when face to face with the enemy; it is sufficient that the commander, who controls, shall so order the battle as to profit by that skill.

Nevertheless, a strong current of opinion manifests itself in favor of fighting at very great range. It has been especially advocated with the object of affording protection to lightly-armored ships against perforating hits. By adding to distance the precaution to present oneself obliquely to the attack of projectiles, an almost absolute protection is *theoretically* secured. As may be seen, we find ourselves again confronted with a defensive system (at every step we come up against the defensive), and if we have not mentioned it before it is because it is denied to be such.

Let us discuss the two arguments upon which it depends: distance and obliquity of impacts.

We willingly admit that distance is an efficient protection; but it has the grave inconvenience of being more advantageous for the one who submits to it than for the one who imposes it, when the anxiety of the latter is to avoid dangerous blows. In fact, oppose to each other two ships unequally armored and of comparable displacements, the *Masséna* and the *Kaiser Friedrich III* for example. The former is less well armed, but better protected; the economies of weight that have been made in the armor of the latter have been expended on her battery. It is the latter, therefore, according to the theory under discussion, that should seek action at long range. She will obtain it without doubt, thanks to her superior speed. At the chosen distance the *Masséna's* shell will be powerless against the hull of the *Kaiser Friedrich III;* that is what is gained. But then the shell of the *Kaiser Friedrich III* will be still less efficient against the *Masséna's* hull. How could it be otherwise since, on the one hand, the latter has 15 cm. more armor, and on the other, the distance that separates the *Kaiser Friedrich III* from the *Masséna* is exactly the same as that which

separates the *Masséna* from the *Kaiser Friedrich III.* On which side is the advantage? On neither side. We see very well what the *Kaiser Friedrich III* will gain, but what the Masséna will lose is not apparent. The two ships are in the situation of two fencers placed out of reach of each other's foils; they will not do any serious damage to one another and they will empty their magazines to no purpose. Which proves once more that in order to do harm to an adversary it is necessary to strike him and not to be content with looking awry at him.

If the *Kaiser Friedrich III* really wants to fight, she ought to approach near enough to break through the *Masséna's* protection; she will then enter the circle of vulnerability to her opponent before the latter is vulnerable to her. Long range is, therefore, clearly unfavorable for her, and she is brought to an *impasse.* She can only get out of it by crossing as quickly as possible the danger zone in which she is exposed to receiving mortal wounds without being able to give them, and by fighting at close range. Paradoxical as this method of procedure may appear, it is the only one that affords good chances of success because it is the one that permits the *Kaiser Friedrich III to use to advantage her superior battery.* And as it so often happens in war, this bold solution is also the most prudent, since intensity of fire is a veritable protection; it extinguishes the enemy's fire, while armor, which cannot be put everywhere, only imperfectly wards off the hits. Evidently, the *Kaiser Friedrich III's* superiority of fire will not instantly dismount the *Masséna's* guns, but all the hits will count and they will produce the effect of a handful of sand thrown into one's face: the pointers will be confused, their fire will become uncertain; before they have recovered their coolness the hail of iron will have done its work. Thus the superiority will accentuate itself little by little and end in the total extinguishment of the enemy's fire, if, as we shall see further on, the combat is not sooner over.[25]

In the two battles of Cavite and Santiago, the American ships could have done without any armor because, from the beginning of the action, they had superiority of fire. Of course we must not conclude that armor is useless, because it is not always so easy to

[25] If being the less protected were sufficient excuse for not closing with the enemy, there never would be an assault.

paralyze the enemy's fire; but it may be said that armor is only really useful during the critical period when the balance rests in suspense.

As for the advantage of obliquity of hits, it only has an absolute value if the enemy is unable himself to use the same system of protection. Well, not only will he be able to make use of this questionable aid, but he will be led to present himself to the projectiles at the same angle as his adversary from the mere fact that he will take the most favorable route for approaching.

We have considered the case of two ships of the same displacement in which one weak element was compensated by the development of another. It may equally well happen that an armored vessel has to fight a ship that is inferior both in armament [26] and in protection. This kind of ship exists; it has a name: it is called an *armored cruiser*. The battle problem can then be examined in every way and from all sides: it is insoluble. And truly, looking at the matter closely, there can be no doubt about it. If the armored cruiser has guns too weak, by construction, to pierce the armor of battleships; if, moreover, she is too little protected to expose herself to the blows of the latter within limits where her own battery is powerless, it is not apparent how any range whatsoever can modify this state of affairs.

The insufficiency of the armored cruiser does not come from the ship itself, but from its comparison with more powerful ships. Since other nations have adopted a type of fighting ship, we are obliged to follow the movement, just as the adoption of a new model of rifle determines a general modification of the infantry armament of all Europe. The armored cruiser is only good against her likes; except in this particular case, it is necessary to employ them on special services. The *Suffren* and *Jeanne d'Arc* are of the same displacement. What could the second do against the first? Be sunk. She would enter the fight without any hope of piercing the *Suffren's* armored walls; on the other hand, she would not be free from anxiety about her own.

In the first edition of this study, in 1902, we added: "The question of the use of armored cruisers will come to the front the day when, in default of battleships, it becomes necessary to put

[26] We understand inferiority of armament here to mean inferior power of guns.

them in the line of battle. History teaches us, in fact, that when one is numerically the inferior he turns everything to account." Certainly we did not think then that it would be Japan that would confirm this forecast. The eight armored cruisers that this nation had at its disposal during the war were constantly put in line with battleships. Two of them served to bring up to six the number of armored ships in the first squadron; the other six formed a second squadron that, at Tsushima, fought in the wake of the battleships. It would have been better, therefore, to have had battleships. In a similar case, France will be obliged to do what Japan did.

* * *

The theory of long-range fighting came into the world with the sound of the guns of the Yalu. It was noted that the protected cruisers of the Japanese had beaten the Chinese squadron; immediately the conclusion was drawn that: 1st, battleships were good for nothing, since they had been defeated; 2d, it was necessary to fight at long range, since the Japanese had done so with such success. At first sight this opinion seems defensible, but it does not stand examination because it rests on a false basis. The Chinese fleet, in fact, was not a squadron of battleships; *it was a squadron that included two battleships.*[27] A part was taken for the whole, and upon this verbal error a legend has been built up.

This is what happened:

Admiral Ito keeps systematically at a distance to protect his coast-defence ships that have no side armor. He forgot that the only distance that can effectively protect ships devoid of protection is one which puts them out of reach of gun fire.

The *Matsushima* makes a trial of it, and a single shell puts her out of action. On the other hand, two Chinese vessels are sunk, and that at the precise moment when, in consequence of incidents of the battle, the two squadrons find themselves close together.[28]

Soon the Japanese have only the two battleships facing them. The Japanese squadron had at this moment an undoubted superiority in gun power, doubled by a great superiority in accuracy and rapidity of gun fire. Nevertheless, under the hail of shell

[27] After the two 7500-ton battleships, the two strongest ships were the *King-Yuen* and *Lai-Yuen*, of 2850 tons each. It is difficult to make these latter pass for real fighting ships.

[28] The *Chih-Yuen* was sunk by a raking shot at point-blank range.

that beats upon them, the battleships stand their ground and fire back feebly. They hold so well that the Japanese end by abandoning the field of battle.

May we not suppose that, if the latter, reuniting their forces, had approached boldly so as to land all their shots on the target, they would have taken or sunk the two battleships? The distance did not permit them to use their heavy guns to advantage and made them lose the greater part of their projectiles. Finally they had to withdraw for lack of ammunition. Without doubt a close action would have occasioned more considerable damages to them, but, on the other hand, the results would have been more important. And since when are battles won without receiving blows? Is it not pursuing a chimera to pretend to do harm to the enemy without exposing oneself? Would it not have been more profitable to catch a few more projectiles and to render unnecessary the Weï-haï-Weï expedition, which was the complement of the Yalu and required sending 24,000 men in mid-winter?

Let us have the courage to tell the truth: the origin of the theory of fighting at long range is bound up with the feeling that impels us always to place ourselves at the limit of vulnerability to weapons; as the lack of reason of this is vaguely felt, arguments are sought to justify it to ourselves (these are terribly like the old discussions relative to the advantages and disadvantages of the windward and leeward positions). The fate of battles is thus made to depend upon small tricks, and the true principles of warfare, which depend on the intelligent valor of the combatants are forgotten.

We must distrust ourselves and let ourselves be guided by reason, not by instinct.

If we really wish to fight, to do harm to the enemy, we must fight at effective range. It is reasonable that the fighting ranges of to-day should be greater than they formerly were: as the range of guns increases, the precision of means of pointing increases proportionally, and the distance that can be considered the most deadly becomes greater. The fighting range is likewise a function of the radius of action of torpedoes, which will surely before very long reach several thousand meters. With these reservations, there is no *à priori* reason for seeking very great fighting ranges. It would even be dangerous to fix a limit within which one ought not to allow himself to be approached. Such an obligation would

necessitate maneuvering under the enemy's fire, which ought always to be avoided in order not to derange the fire control; and it would lead to fighting in retreat. When battle is engaged it is necessary to accommodate oneself to the range, whatever it may be. If it is thought not to be a good range, there will be consolation in the thought that the enemy is no better off.

Let us observe, moreover, that the appearance of a great seaman upon the scene has always been marked by a shortening of ranges. The reason is very simple: he who wishes the end wishes the means.

We are unanimous in admiring the fiery ardor with which Suffren precipitated himself upon the enemy, seeming to say to his captains: *Come and seek for me.* Our admiration is not alone on account of the disdain of shot that Suffren exhibited; we feel that his line of conduct was the only one that could lead him to his ends—the annihilation of the English East Indian squadron. We perceive clearly the immense results that he would have attained if his captains had followed him, and we are grateful to him for the lustre that he has shed upon our arms. Yet, as soon as we put ourselves in the same situation as his, we seek to escape the solution; we deceive ourselves by specious arguments. Naturally we thus arrive at a diametrically opposite conclusion. It all comes from a lack of moral courage;[29] there are in life many situations in which we knowingly adopt the worst part; in acting thus we obey a natural sentiment that impels us always to put off the critical moment, even at the cost of letting our situation grow worse. It is human. We see the immediate effort; we shrink from it and hope that a chance occurrence will deliver us from the complications that we see less clearly because they are further removed.[30]

The eternal compromise upon which a navy is built (and which results from the nature of its medium) pursues us onto the field

[29] The reference here is to moral and not to physical courage. The latter, in France, is rarely lacking, but it is often blind and not suitable for a chief of squadron, who ought beyond anything else to conserve his clearness of thought.

[30] Cruising affords us daily examples of this state of mind. Influenced by the weather, the gathering sea, dangers that surround, we refrain from entering a difficult passage, stand out to sea and put ourselves in a critical situation for several days, enduring the tempest without knowing where we are. An effort of will would have sufficed to gain the port in a few hours.

of battle. It offers only two advantages, number and energy. Number is mass. Energy is battle at efficient range. The rest is but sophistry. Moreover, moral ascendency cannot be taken at 8000 meters distance; to impose one's will upon the enemy it is necessary to have him in one's power, and to force him to choose between two equally bad solutions, surrender or flight.

Battle at long range, therefore, ought not to be sought, though one may be obliged to submit to it. It will then offer chances of success on condition that one persists in approaching. The enemy will thus be obliged to withdraw to maintain the distance, and it will inevitably result that the chaser will fight on the bow, while the chased will fire on the quarter of the opposite side. Besides that these relative positions usually give superior fire to the one that fires forward, they offer the special advantage of making any ship that an injury forces to slow down, even momentarily, fall into the chaser's hands. The fire of the heavy guns will then be concentrated on a part of the enemy's ships to create breaches ahead; the last ships will be chosen by preference, or those that are far from the admiral, because the latter will not perceive at once accidents that take place at a distance. The chase will then be forced to accept close action or to abandon his laggards to certain loss.

In short, long-range battle is an equitable distribution between attack and defence; it gives to one what it takes from the other. Well, it is not so that war is made: one attacks or one defends himself. In the former case, one employs all his offensive means, which leads to drawing near; in the latter case, one develops all his defensive means, which leads to flight. It is so at least that things happen at sea, where there are no natural obstacles; for as far as the artificial protection given by armor is concerned, that cannot be altered at one's will, it is what it is. If we seek to render it more efficient by distance, the adversary's protection is increased by an equivalent amount. War is compelled to submit to compromises in things, but it does not put up with half-way measures in deeds.

A linear distance cannot advantageously be made to take the place of the vigor and dash of attack.

VI.

The Order of Battle and Position for Fighting.

One does not fight without order; whence it naturally results that there is an order of battle. At least this is an opinion that is held to be an axiom.

In order to adopt an order we have only the difficulty of choice. From long ago this question has been endlessly discussed. Some accept nothing but the line ahead, which is manageable and requires no signals; others advocate the line of bearing, which gives a clear field of fire and permits maneuvering by simultaneous movements; still others hold to triangular formations. Each extols the advantages of the order of his choice and dwells with complaisance upon the difficulties of others. All seem to be right, and the arguments that are developed are all the more convincing because no one takes account of what the enemy will do.

If from theory we pass to practice, we see that at the battle of the Yalu the line ahead defeated the double echelon; but, on the other hand, the double echelon beat the line ahead at Lissa. Going still further back, we come upon an even stranger state of affairs: on several occasions the vanquished had an order in which he felt full confidence, and no trace of one is to be found on the side of the victor, who broke his ranks even before getting within gunshot.

Where lies the truth? For if line ahead suited Admiral Ito, he was right to adopt it; and Tegethoff, who preferred double echelon, was not wrong.

Nevertheless, without wronging the victors, we may remark that the line ahead is sometimes dangerous, since it made the tail of the Japanese squadron fall into the midst of the Chinese ships, and that the Austrian double echelon would perhaps not have been so advantageous if the Italians, after having concentrated, had presented their bows in any formation whatsoever. The formations adopted in the two special cases of which we are speaking were, therefore, appropriate to the circumstances, but their efficacy is not absolute. Which amounts to saying that the order of battle

has no proper value; it has value only for that which it is desired to do with it.[31] Like tactics in general, of which it is one of the elements, the formation should only be the instrument of a will; this will pursues an objective; the order of battle is for the purpose of realizing it. Were the commander to subordinate his designs to the employment of a more or less attractive formation, he would become its slave and no longer have full liberty to do what he wished.

The sole advantage of the order of battle is to furnish a solution to him who, not knowing what to do, falls back upon official prescriptions.

On the other hand, the enemy has liberty of movement so long as he has not been immobilized by an attack driven home. In our ignorance of the fashion in which he will present himself, is it not to be feared that a fixed order will betray us, if the enemy is unskilful enough to disconcert our previsions?

In short, the order is of less importance than the relative positions of the combatants; for the fine array of a squadron does not constitute a force by itself. From the obligation of establishing a connection between the respective positions of the two sides, we draw the conclusion that it matters little to have an order of battle; every effort ought to be exerted to give one's forces a favorable position for fighting. Moreover, an order is always more or less defensive, since it is determined by the position of ships relative to one another and not in relation to the enemy.

The order of battle has had its glorious days. When two adversaries employ the same means, one of them, none the less, is victor, even though, as we have already said, the line ahead has occasioned many indecisive encounters. And so we have not to inquire whether one order is better than another, but whether more importance should not be attributed to the position ships occupy in relation to the enemy than to the order in which they are arranged.

[31] Example: If the admiral wishes to draw away from or approach the enemy, line ahead is unsuitable; the necessity of having the last ship follow in the wake of the first amounts to a diminution of speed; simultaneous movements are then preferable. On the contrary, the line ahead is favorable for enveloping movements, if one is skilful enough to clear the tail of the line. At short intervals, therefore, the admiral may be led to make use of either line ahead or simultaneous movements.

The first fleets of sailing ships adopted a crescent as the order of battle. Why the crescent rather than the line or any other formation, it is hard to say. All that is known is that this order came from galleys, and sailing ships seized upon it without any particular reason, doubtless because it existed; the same as later auxiliary steam vessels adopted the line ahead of fleets under sail. It was in this order that the Invincible Armada withstood the English attack. The English fleet was less numerous and very heterogeneous. Under the menace of an invasion that threatened to overthrow her rule, Queen Elizabeth had assembled all the ships that could be found, war vessels, merchant vessels, long-boats. With such diverse forces, Lord Howard could not think of adopting any order whatever. It was England's safety; for Howard employed a very much more efficient method, and, renouncing order, he had no other object than concentrating his efforts on the weak points of the enemy. He threw Drake and Seymour upon the two horns of the Spanish crescent. Attacked by superior forces, the wings gave way and threw themselves in disorder upon the center, where an inextricable confusion soon reigned. Chaos ensued; the Invincible Armada ceased to exist.

In consequence of this disaster, the prestige of the crescent formation went to pieces and it was heard of no more.[32] But it appears that at this period the cause of the English victory was not clearly perceived and it was attributed rather to the weakness of the formation than to the disposition the English admiral had given his forces; for, during more than a century, naval battles are only confused mêlées. In the midst of this chaos fire-ships made havoc; penetrating into the mêlée, under cover of the smoke, they fell with impunity upon hostile ships that were imprisoned on all sides and could not avoid them. It also happened that fire-ships burned up friends as well as foes. Then the disadvantage of lack of order was taken account of and a formation was again adopted that was the line ahead.

During the whole of its reign, there were from time to time found admirals who sought a fighting position in order to crush a part of the enemy's forces, but, in attempting to gain their ends

[32] It would be more exact to say that it was no longer employed; for it is found still mentioned in the *Hydrographie* of P. Fournier, in the 17th century.

by means of learned evolutions so as not to break their order, they disclosed their projects and facilitated the counter movement. We find a fighting position clearly characterized only in the cases of Suffren and Nelson, for whom the formation is merely a means, anterior to the battle, of holding their forces in hand so as to throw them subsequently upon the enemy in a determined position.

We know the virtues that are attributed to the permanent maintenance of the formation; it is desired that the commander have his forces constantly in hand to direct them at his will. This is an ideal that appears impossible of realization during the whole of the battle. It is too often forgotten "that it is easier to let loose the tempest than to guide it"; so that the rôle of the chief of squadron will consist principally in distributing his forces; after which he will be obliged to let them act. Materially, the ships will seem to escape from his control in so far as beautiful general maneuvers are concerned; morally, his action will make itself felt much more powerfully than could the ready made phrases of a signal, if he has known how to instil into each captain the line of conduct he ought to follow. "The leader's guiding thought hovers over the field of battle." [33]

The object to pursue is, therefore, to distribute one's forces in such a manner as to hurl them in a mass upon the weak points of the enemy, to strike him a deadly blow at the very start. To attain this object it is not necessary to have *an order;* it suffices to maneuver *with order.*

A fighting position much sought after in the old navy was one that brought a part of the enemy's vessels between two fires. There were several reasons for this: a ship attacked on each side could not make use of all her guns on account of lack of men; shot entering through the ports took effect upon the gun's crews on the opposite side; finally, the arc of train of the guns was too restricted to enable two vessels to concentrate their fire on the same target and on the same side. To-day the position between two fires allows the use of a certain number of guns that can fire only on one broadside; the protection of guns in casemates or closed turrets does away with hits from behind; finally two vessels that engaged a third on opposite sides would risk receiving each other's shots. It seems preferable, therefore, when an extremity can be

[33] Jurien de la Gravière.

attacked with superior forces, to arrange one's ships in two perpendicular lines. The right-angled formation, however, is not imperative; in reality it suffices that the fighting position embrace the enemy's formation, while leaving one of his sides disengaged.

In all that precedes we have assumed that the enemy has preserved his order. It has often happened that even before the battle has been entered upon he has found himself divided into several fractions. There should be no hesitation then in interposing in the passage that he leaves open. The position between two fires is thus deliberately assumed; but if we have not found it worth while to put the enemy's ships in this position, that is a reason for seeking it for our own. There is, nevertheless, a certain prepossession against engaging on both sides on account of the moral effect produced by it. This effect depends much upon the distance; it will not be the same for a vessel closely engaged as for one fighting at long range. Moreover, one can find himself between two fires without being at an equal distance from each of them. Furthermore, there are in war situations whose consequences differ according to the state of mind that animates each side. This peculiarity is brought clearly out by two movements that are frequently employed, one of which consists in turning the enemy and the other in cutting through him. In the latter case one seeks the position in which in the former case it is wished to put the enemy. Yet it cannot be denied that each mode of action has its *raison d'être,* and the explanation is that on one side the maneuver is *willed,* while on the other side it is *submitted to.* War maneuvers have value only through the spirit that directs them and permeates the combatants. If this consideration is not taken into account, criticism goes astray.

If, then, advantage is taken of the dispersion of the hostile forces to separate them definitely, the maneuver, being intentional, has no evil consequences from the moral point of view, and it enables bringing into play a certain number of guns that would otherwise remain idle. All one's efforts should then be directed against the principal body; by attacking the weaker fraction (which there is a tendency to do), the main body is given opportunity to come to the rescue. On the contrary, if the portion that finds itself let alone is too inferior to think of maintaining itself in the vicinity of the hostile forces, it will begin, first of all, by drawing off. If the affair is compromised, it will definitely

quit the battle field; if victory remains doubtful, it will endeavor to rejoin by a long detour. There will, therefore, be time to reduce the main body.

At the battle of the Yalu, the Chinese forces found themselves split up from the beginning. Admiral Ito likewise divided his own; and this maneuver does not seems to have had any apparent advantages.[34]

There exists a method, when the enemy does not give any hold upon himself, of obliging him to divide his forces: it is to pass through him. We will not dwell upon this because it is supposed that the ram and torpedo make such an operation impracticable.

It would be well not to be too sure about this. Nothing proves that a column, taken on the flank by a compact force, will not open to give it passage from the mere fact of the pressure that the mass will exert at a point. Nevertheless, there is an uncertainty here that a responsible leader alone can clear up.

[34] See, on the subject of the division of forces, Jervis' maneuver at Saint-Vincent, which is a model example.

VII.

The Period of Approach.

The ground having been cleared, we can now pass on to the different phases of the actual battle. We are thus brought to consider, first of all, the period of approach, which lasts from the getting into touch until the moment when battle position has been taken.

Most of those who have studied naval questions have attributed to this phase an importance that would make it out to be the battle itself. Current ideas upon this subject may be summed up in the following manner: when a naval force meets the enemy, it will begin by exchanging some preliminary passes with him for the purpose of feeling his strength; the contest will continue thus until, a beginning of superiority having been acquired, a definite advantage is sought by engaging fully.

This theory is so wide-spread that we even find it applied to the attack of coast batteries.[35] It arises from an anxiety to be able to withdraw in time, or not to engage except on a certainty.

If this method of procedure realizes the object that is in view, there is no reason for not adopting it; if it does not, it must be repudiated, because it can lead to a result diametrically opposite to the one that is sought.

To elucidate this question, we have to consider two eventualities: the engagement turns against us, and we withdraw; or it is favorable to us, and we take a step forward.

[35] Here is what may be read in a work entitled: *Des Opérations maritimes contre les côtes et des débarquements* (par M. D. B. G.): If, in this action at 5000 or 4000 meters, the battery's fire is conducted with skill and rapidity, it may very well happen that the ship suffer damages so serious as to cause her to abandon the struggle. In the contrary case, and if the battery has suffered from the ship's fire, which will be indicated by its slackening its own fire, the ship will approach to attempt the decisive attack and will place itself at a less range, 3000 to 2000 meters. The ship's fire will then become more accurate, for the battery will be clearly seen , . . . " All this is quite correct; but then why should the ship linger in a position where it can only take bad blows with no chance of returning them, instead of approaching as soon as possible, to 1000 meters range? It is a fool, that ship; if it wishes to fight only upon condition, it has only to stay away altogether.

Let there be no deception here; we should be cheating ourselves if we imagined that we would be free to quit the battle field at will; it is necessary either to remain its master or to abandon trophies. Retreats in good order exist, as far as navies are concerned, only with the consent of the adversary. In such cases there is neither victor nor vanquished; each withdraws by common consent. This is not the sort of combat (common though it once was) that concerns us; it leads to nothing. It must be admitted, when there is serious fighting, that if one of the combatants yields the field because he has already suffered from gun fire, the other will wish to prevent him from doing so. And then we fall back into the battle in retreat, with the aggravating circumstance that the pursued is already in a precarious condition. The tentative period will only have served to prepare a disaster. If it is not thought that a successful battle can be fought, it is necessary to attempt to escape as soon as the enemy is signalled; but when foot has once been placed on the field of battle *one will find himself caught in a mesh* and it will be necessary to make a stand.

Let us come now to the second supposition. Many shots have been exchanged, and the enemy's fire appears to slacken; then, but only then, will one think of pushing further this first advantage. But in war advantages do not come about of their own accord; they must be won by dint of energy; well, it is not apparent what would give us this first advantage, since by hypothesis we are holding ourselves in reserve. It can only be *the lucky hit* that is so often heard of, the shell which, striking normally at the water-line, will put out of action a 15,000-ton battleship.

Which will receive this lucky hit? Our ships or those of the adversary? Fate will decide. If there is no solider ground than this, one won't go under fire very heartily. Chance will always have a part in the operations of war, but, in principle, one can only count upon himself. Let us take advantage of all that it offers us, the more the better, but let us avoid counting upon it; it always betrays those who trust their destinies to it and favors only people who can get along without its aid.

Moreover, the effects of chance will depend much upon the field that is given over to it. It is, therefore, necessary to reduce to a minimum the time during which its action will make itself felt indifferently upon one or the other of the opposing forces;

which leads to diminishing as much as possible the period of approach, during which one cannot impose one's will upon the adversary.

To maneuver would be inopportune. In a game that is played openly, like a naval battle, rapidity and impetuosity of attack alone permit forestalling the enemy and preventing him from preparing the counter thrust. By lingering over and prolonging the groping period, he is given time to reflect and himself to assume the offensive. Besides, as soon as fire is opened, the signal halliards will be cut, injuries will begin to occur, the commanders, shut up in conning-towers, will no longer be able to execute precise movements. If the situation is prolonged, the water that the state of the sea or the rolling will bring aboard through breaches in the side will become disturbing, the vessels will be forced to slow down; under these circumstances complicated evolutions would only accentuate the disorder that will not be long in appearing in the formation. A few simple maneuvers, foreseen and practiced in advance, will alone be possible; they will serve to bring the ships within effective range of the enemy and in the position that appears to the admiral most favorable. It is at this instant that the qualities of the commander will reveal themselves; upon the manner in which he succeeds in placing his forces will depend the fate of the battle.

Such is the object to be attained; but it is as difficult to realize as it is easy to define. Yet it would be dangerous to wish to penetrate further in the face of the unknown of the battle field; we have reached the critical moment when the situation alone can inspire resolutions. Before coming into contact with the enemy, the admiral will without doubt know what he intends to do; but he will not yet know how he will do it. The enemy alone, by his dispositions, will determine the line of conduct to be followed.

At the point where we now are, tactics can do no more than aid the admiral in executing his design; it is powerless to suggest this design to him.

* * *

It is important to establish a very clear distinction between the period of approach that constitutes the presentation to the battle and the battle itself.

During the first phase fire is not opened; we are not troubled by

the enemy's fire. All our means are then available and there is no reason not to make use of them. It will, therefore, be possible to maneuver, and, except for the nervous strain that results from the nearness of the enemy, maneuvers will present no special difficulties.

During the second phase, on the contrary, we shall no longer have the use of the compass; the signal halliards will have been cut; the steersmen will be under shelter. There will be no more thought of maneuvering. Were it wished to maneuver, it could not be done.

Accordingly, one maneuvers or one fights; one does not maneuver while fighting; for maneuvers, were they possible, would derange the fire.

It is, therefore, absolutely useless to have in view a tactics without signals; for, so long as one is not interfered with by gun fire, there is nothing gained by depriving oneself of signals; and when it becomes impossible to make signals it will be equally impossible to maneuver.

Nevertheless, the search for a tactics without signals shows that a proper distinction is not made between the presentation to battle and the battle; and it seems as though we intended to twist and turn under the enemy's very nose without paying any attention to the tempest that will be let loose upon us.

This error might occasion us disagreeable surprises, and what can have given rise to it is not apparent. During the actions of the Russo-Japanese War the Russians never maneuvered; at the most they changed direction by counter-marching. The Japanese, on the other hand, whether on the 10th of August or at Tsushima, made simultaneous movements on several occasions; but it seems beyond doubt that these movements were always executed during suspensions of the gun fire, when, in consequence of incidents of the battle, the adversaries found themselves momentarily separated. We have no right, therefore, to give weight to these evolutions, and it is more prudent to admit that, just as in battles on land, a naval force that is seriously engaged can do nothing else but make head against the enemy.

* * *

It is easy to persuade oneself that battles will always be begun in the same way, the two forces advancing each towards the other,

and that, from this very fact, they will be led to make the same movements, since they will find themselves in identical positions that will determine common necessities. It may be objected that the two sides will seldom hit upon the same plan, and that, consequently, the first maneuvers will quickly destroy the symmetry of the initial positions. Moreover, war gives rise on each side to different objectives which influence the manner of presentation on the battle field.

At Lissa, the Italian admiral's objective, which was the capture of the island, had its reaction upon the distribution of his forces. At the Yalu, the landing of troops brought about the separation of the Chinese forces. At Cavite, the weakness of the Spanish vessels forced upon Admiral Montojo an action at anchor, under shelter of the forts, while at Santiago the same consideration had for its consequence a battle in retreat. On the days of August 10 and Tsushima, the passive attitude of the Russians allowed the Japanese to present themselves to battle without being obliged to take account of the adversary's movements, and this attitude was a consequence of anxiety to get to Vladivostok. We do not mean to say that the methods adopted in these various cases were the best that it was possible to employ; it is none the less true that similar circumstances may arise that will prevent battles from beginning in a uniform manner.

[TO BE CONCLUDED.]

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SOME MODERN DEVELOPMENTS IN METHODS OF TESTING EXPLOSIVES.

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As has previously been pointed out in these pages the greater proportion and the larger variety of the explosives that are annually produced are consumed in the industries and a very considerable proportion of these are consumed in the winning of coal. As is well known this most important industry is attended by many hazards, not the least of which is the constant danger of explosions owing to the presence of fire-damp and inflammable dust in these mines. Most serious accidents from these causes which have been attended with frightful casualties have frequently occurred, and their frequency and magnitude have increased as the demand for coal has increased until the public conscience has been aroused and efforts have been made by individuals and by governments to devise means by which to reduce the number of these explosions and limit their scope.

Consideration of the conditions attending such of these catastrophes as were carefully investigated made it evident that many of these mine explosions have been initiated by the explosives used in the mines, and therefore the behavior of a large variety of explosive compositions, when fired in dusty and fiery atmospheres, have been studied experimentally with a view to selecting from among them those which, while capable of doing the work required of them efficiently at a reasonable cost, and while possessing such qualities as to render them reasonably safe in transportation, storage and use, were least liable to ignite the fire-damp, or coal-dust-air mixture, or mine-gas-coal-dust-air mixture found in mines.

For this purpose it became necessary to have a chamber in

which the gas and dust could be introduced, and the explosive fired, at will, and all the conditions of the experimental trials be known and under control. Beginning some 30 years ago, many kinds of chambers have been employed, from one made of boiler iron mounted on wheels used at Zwickau, Germany; an abandoned mine tunnel used at Rossitz, Austria; a wooden gallery used at Frameries, Belgium; a concrete gallery used at Lievin, France; to metal galleries as used at Woolwich, England, and Pittsburg, U. S. This last is one of the most modern of these testing galleries, it having been erected on the arsenal grounds by the Technologic Branch of the U. S. Geological Survey in 1908, and as it was designed after careful study of the characteristics of different galleries abroad it may be regarded as representing the latest type of testing chamber.

This chamber, which is styled Gas and Dust Gallery No. 1, is shown in Fig. 1. It consists of a cylinder 100 feet in length and 6⅓ feet in diameter, which is built of boiler-plate steel, in five divisions, each consisting of three sections, 6⅔ feet long. The gallery is closed at one end by a concrete head. The different sections of the gallery are for convenience in operation, numbered consecutively from 1 to 15, beginning with the section nearest the concrete head. Sections numbered 1, 2 and 3 are made of ½-inch plates, the remaining sections of ⅜-inch plates, and all of steel having a tensile strength of not less than 55,000 pounds to the square inch. The sections are held together by lap joints, at each of which there is on the interior of the gallery a ring, formed of 2½-inch angle iron, upon the face of which paper diaphragms may be so secured as to partition off any desired portion of the gallery at will, and thus provide a closed space of any desired volume, within the capacity of the gallery, in which to enclose the gas-air, coal-dust-air, or gas-coal-dust-air mixture to be used in the test.

Each section is provided with a pressure-release door placed centrally on top, which not only provides a vent by which the gases may immediately escape after the explosion, and thus acts as a safety valve to prevent the destruction of the gallery, but also affords an approximate means of estimating the pressures developed. Each door closes on a rubber gasket and is provided with a rubber bumper on its back to prevent injury when thrown open violently. In use each door may be left open, or closed but not

FIG. 1.—GAS AND DUST GALLERY, NO. 1, PITTSBURG TESTING STATION.

Fig. 2.—Barricades at Mouth of Gallery.

fastened, or closed and fastened, as seems best under the experimental conditions which obtain.

Each section is provided with a stout plate-glass window placed in the center of the section on the operating side of the gallery through which the progress of any flame produced in the gallery may be viewed and noted, while an indicator cock, tapped into the central section, provides a means by which samples of the mixtures in the gallery may be taken for analysis.

The gallery is so connected with the natural-gas supply used in Pittsburg that it may be filled with gas at will, and the quantity charged is measured by a meter which can be read to 1-20 of a cubic foot. The air and gas are mixed by means of circulating systems exterior to the gallery, operated by Monogram exhausters. The circulating system for the first division is stationary and includes steam-heating coils by which to bring the mixture in the gallery to a constant temperature. The remaining divisions of the gallery are served by a portable device.

When coal-dust is to be used, it is spread on a series of shelves 20 feet long by 4 inches in width lining the gallery, there being four of these on each side, and in addition upon a steel trestle, having a surface 20 feet by 12 inches, which is placed for that purpose in the first section of the gallery when coal-dust is to be used. This dust is always freshly ground from lump coal to 100 mesh in fineness just before using.

In addition the gallery is provided with a humidifying apparatus provided with a Koerting exhauster, having a capacity of 240,000 cubic feet of free air per hour, by which the effect of moisture in preventing the propagation of explosions may be quantitatively ascertained.

The explosives to be tested may be suspended in the chamber and fired in the prepared atmosphere, and this method has been pursued at some stations, but the regular practice at the Pittsburg Testing Station is to fire the charge in a special "cannon," as this more nearly simulates the conditions in mining where the charge is fired in a bore-hole in coal or rock. These "cannon" are cylinders 24 inches in diameter by 36 inches in length, with bore-holes 2¼ inches in diameter by 21½ inches in depth. The simplest of them have been made in one piece from a low-carbon-steel, or nickel-steel, forging. Others have been built up from centrally perforated jackets of cast steel, vanadium steel or

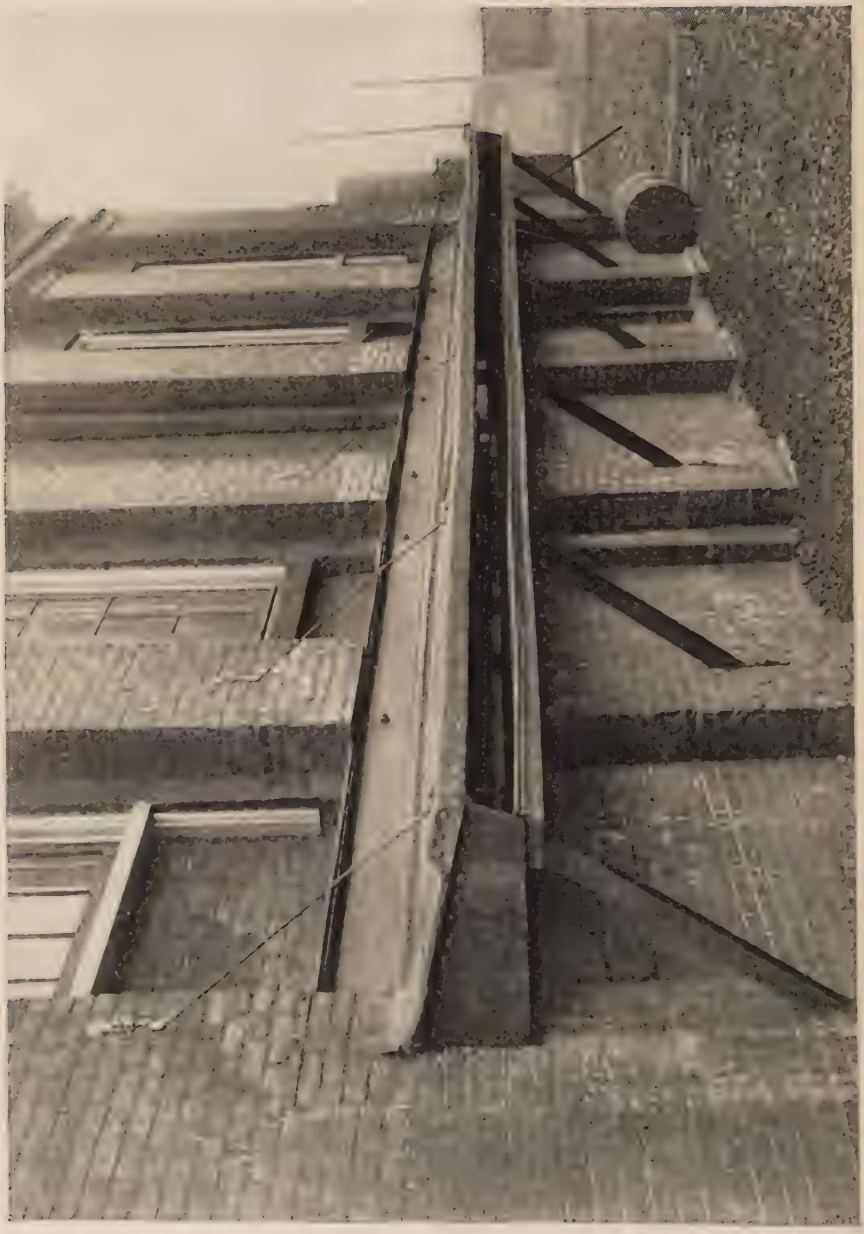
other iron alloy, and a liner of nickel steel or other metals or alloys. In repairing, after erosion, the liner has been formed by the Thermite process. No definite conclusions have yet been reached as to the relative merits of the different forms of construction. These "cannon" are shown in the right foreground of Figs. 2 and 4 and in the center of Fig. 6.

The "cannon" is imbedded in the concrete head of the gallery and is so laid that its axial line coincides with the axial line of the gallery. The "cannon" is loaded from within the gallery, but the charges are fired by electric detonators for high explosives and electric igniters for explosives of the gunpowder class, the firing machine being located in an observation room 60 feet distant from the gallery. The larger part of the explosives tested are detonated, and they are fired both stemmed and unstemmed into the sensitive mixtures.

As, when the explosive mixtures in the gallery are fired, the blast from the mouth of the gallery is very destructive in its effects, two concrete barricades are erected on each side of the mouth of the gallery, and a thick iron plate is so suspended on a frame across, but at a distance of 50 feet from, the mouth of the gallery that it may so swing as to deflect the blast and arrest any flying stemming or other material which may be blown out of the gallery. This arrangement is shown in Fig. 2, which also shows the reinforced-concrete foundation in which the gallery is set and specimens of the "cannon" used. The violence of the gallery explosions initiated by the charges of explosive used may be judged from Fig. 3, which is a photograph of an explosion of a coal-dust-air mixture.

The observation room from which the charge is fired, and the visible phenomena occurring in the gallery observed, is shown in Fig. 4. This room is 40 feet long by 9 feet 5 inches wide, built with brick walls 18 inches thick and provided with a heavy plate-glass window, 37 feet long by 6 inches wide, which is protected by two projecting wooden guards. This room with its window is made so large in size that it may not only provide a large field of sight, but that it may accommodate a considerable number of persons, for the station is designed to be educational as well as experimental, and coal miners are brought there in large numbers to be convinced by experimental demonstrations of the accidents that may arise unless they use the explosives recommended by the station, and use them in the prescribed manner and amount.

Fig. 3.—Explosion of a Mixture of Coal Dust and Air.



Prior to testing the explosives in the gallery, which is both costly and time consuming, they are subjected to other tests which may show them to possess such characteristics as to render them unfit for use and render the gallery test unnecessary. Thus they are inspected physically and analyzed chemically, and an admirably equipped and well-manned laboratory is provided for this purpose. Among other tests the gravimetric density of the material, in the original package in which it would be used in the mine, is determined by the aid of dry sand as the mobile medium, and this density is carefully preserved in those tests in which density is a factor.

One of the first tests to be made is the determination of what is styled the "Unit-Disruptive Charge," which is ascertained by the aid of the ballistic pendulum shown in Fig. 5. This apparatus consists essentially of two parts; the "cannon," in which the charge is fired, and the pendulum, which receives the impact of the products of the explosion, and that of the stemming when the latter is used. The "cannon" is identical in form, construction and proportions with those used in the gallery. It is mounted on a four-wheeled truck, to which it is made fast by straps and rods. The truck runs on a 30-inch track which is provided with a recoil bumper placed 9 feet from the face of the pendulum mortar. The "cannon" is carefully placed axially in line with the pendulum mortar.

The pendulum consists of a 12.2-inch army mortar, weighing 31,600 pounds, which rests in a stirrup made of two 1½-inch machine-steel rods bent in a U-shape. The ends of these rods pass through a solid steel supporting beam and are held fast to it by cast-steel saddles fitting over the beam. This beam is provided with two nickel-steel knife edges countersunk in its lower face, which rests on bearing plates provided with small grooves that permit of the knife edges being kept in oil, so as to be protected from the weather. The bearing plates rest on base plates which are anchored to the concrete piers between which the pendulum mortar swings.

The concrete piers are each 51 by 120 inches in dimensions at their bases and 139 inches high. The outside walls taper while the inside walls are vertical, and there is a clearance of 60 inches between these piers. A firing line, with a coupling box, is attached to the left-hand pier and by its aid the firing may be done from a safe distance.

The extent to which the pendulum mortar is deflected is measured by a detachable device consisting of a graduated scale with its vernier, which are set on a steel base fastened to a concrete footing below and to the rear of the mortar, the movable parts being actuated by a contact rod, set in guides, which bears at one end against a stud-bolt in the bottom of the mortar directly below the point at which its center of gravity is located, and, at the other, on the scale. The radius of the swing of the pendulum mortar measured from the knife-edge bearings to the center of the contact rod, or to the base of the stud-bolt, is 114 7-16 inches. The radius of the swing measured from the knife-edge bearings to the center of the trunnions of the mortar is 89¾ inches. The recording device measures the deflection of the pendulum to within the 1-100 part of an inch.

The standard used for this test is 227 grams (½ pound) of 40 per cent straight dynamite, stemmed with 1 pound of dry clay, tamped with tamping sticks of standard pattern under a uniform rate of pressure and fired with a No. 6 electric detonator. The unit-disruptive charge of another explosive is that weight of this explosive that will, when fired under the prescribed conditions, give the same deflection of the pendulum mortar as the standard dynamite charge does.

In making the test after the recording device is set, the "cannon" is loaded in the prescribed manner and rolled up to within 1-16 of an inch of the muzzle of the pendulum mortar and stops are so placed that this distance is maintained when the flanges of the wheels of the truck are against them. The legs of the detonator are then connected to the firing line and the party loading, who has also been carrying the safety plug with him, retires to the firing machine, inserts the safety plug and fires.

Firing trials with the standard show that variables enter here and that the same pendulum deflection is not invariably obtained with equal weights of charge of the standard dynamite, even though the successive charges are tamped in the "cannon" with the same degree of pressure, stemmed with the same weight of fire-clay and fired by the same numbered detonator. A condition affecting this result is the distance of the "cannon" from the mortar, and hence, as shown above, this distance has been definitely fixed. Another is the position of the knife edges supporting the pendulum mortar, and to eliminate the effect of this the knife

FIG. 5.—BALLISTIC PENDULUM.

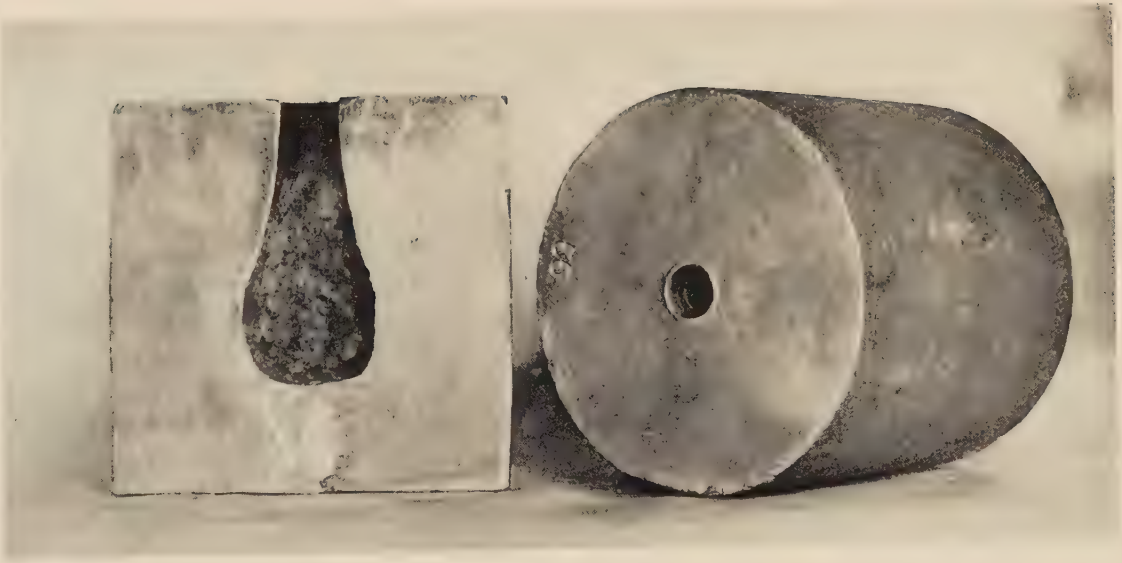
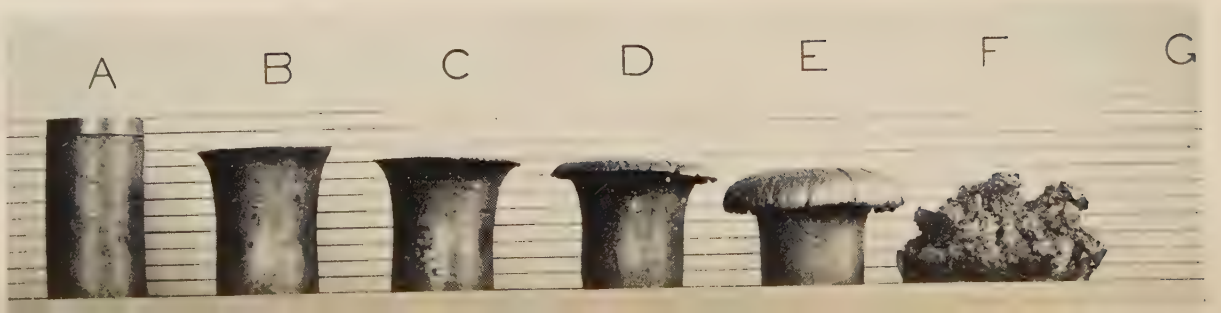


FIG. 6.—TRAUZL TEST.



edges are trammeled before each trial. Other factors affecting the results are the direction and velocity of the wind, the condition of the bore-hole in the "cannon," and that of the person charging the "cannon." No one of these can be controlled absolutely. Hence the explosive to be tested must be proved in this ballistic-pendulum test directly against the standard, both being handled and charged by the same person on the same day, and as nearly as possible under the same conditions, for this tends to eliminate the personal equation, through its effects becoming nearly uniform, and to eliminate the effects of wind and weather, since they are fairly uniform during the trial periods. The condition of the bore-hole is the existing variable factor which is the most difficult of elimination.

The energy of the explosive is further ascertained comparatively by the Trauzl and by the small lead-block tests. The device used in the Trauzl test is shown in Fig. 6, which consists of lead blocks 200 millimeters in diameter and 200 millimeters in height, in which holes 25 millimeters in diameter and 125 millimeters in depth are bored centrally in the top. These cylinders are cast from desilverized lead and all used in the same series of tests are carefully prepared under identical conditions and from the same melt. The volumes of these bore-holes are carefully measured by means of water.

Ten grams of the explosive, weighed on a balance of precision, are wrapped in similar-sized pieces of tin foil, together with a No. 7 electric detonator, and the whole inserted in the bore-hole of one of these cylinders, then 40 cubic centimeters of dry Michigan dune sand, of such fineness that it will all pass through a 50-mesh screen and be caught on an 80-mesh one, are poured into the bore-hole and tamped ten blows with an automatic-tamping device, which operates on the principle of an automatic-center punch, and delivers blows of known magnitude over a definite area. Then 10 cubic centimeters more of the same sand are poured in and tamped with forty blows of the tamping device. The loaded cylinder is placed on a piece of heavy shafting imbedded in concrete, which forms a rigid support, the temperature of the block is ascertained to make sure that it is 15° C., and, when this is attained, the charge is fired. The cavity is again measured by calibration with water and the increase in volume produced by the charge of explosive fired is compared with that

produced by an equal weight of the standard dynamite fired under the same conditions. The Trauzl test is quite widely used, and abroad it has been recommended that the cylinder be covered by a lead plate secured by a yoke. But it is found that in putting on the yoke the charge and stemming were disturbed and, as uniformity in these last particulars are of much more importance in these comparative tests than a greater degree of confinement, the plate and yoke are not recommended.

The Trauzl test measures comparatively the displacing effect of an explosive under moderate confinement. The small lead-block test measures comparatively the pressure exerted in contact by a charge of explosive which is detonated or exploded unconfined, or, in other words, the percussive effect. The blocks used, and the deformations produced on some of them are shown in Fig. 7. The lead blocks employed are cylinders 1½ inches in diameter and 2½ inches high. The charge of explosive used is 100 grams. Since an unconfined charge of high explosive, such as the standard dynamite, would, on detonation in contact, deform the cylinder beyond measurement, as shown by *F* in the figure, a disk of annealed steel 1½ inches in diameter and ¼ inch in thickness is placed upon the lead cylinder. Since this plate retains a portion of the energy expended the compressed cylinders record only the residual energy.

In making the test, after placing the steel disk on the cylinder, a strip of manilla paper is so secured about and beyond them as to provide a container, above the plate, for the explosive to be fired. The cylinder is then placed on a rigid support, the carefully weighed charge of explosive poured in and so tamped as to acquire the specific gravity it possessed in its original container, the No. 7 electric detonator inserted, and the charge fired. The height of the compressed cylinder is then ascertained with precision, and this comparison, as compared with that produced in a cylinder subjected to the detonation of 100 grams of the standard dynamite, is styled the relative percussive force of the explosive.

A more accurate idea of the pressures produced by an explosive may be obtained by means of the Bichel pressure gage which is employed to determine the "maximum pressure of an explosive in its own volume," by which is meant the maximum pressure which an explosive exerts when exploded or detonated in a space which it fills completely, and when all of the heat set free through

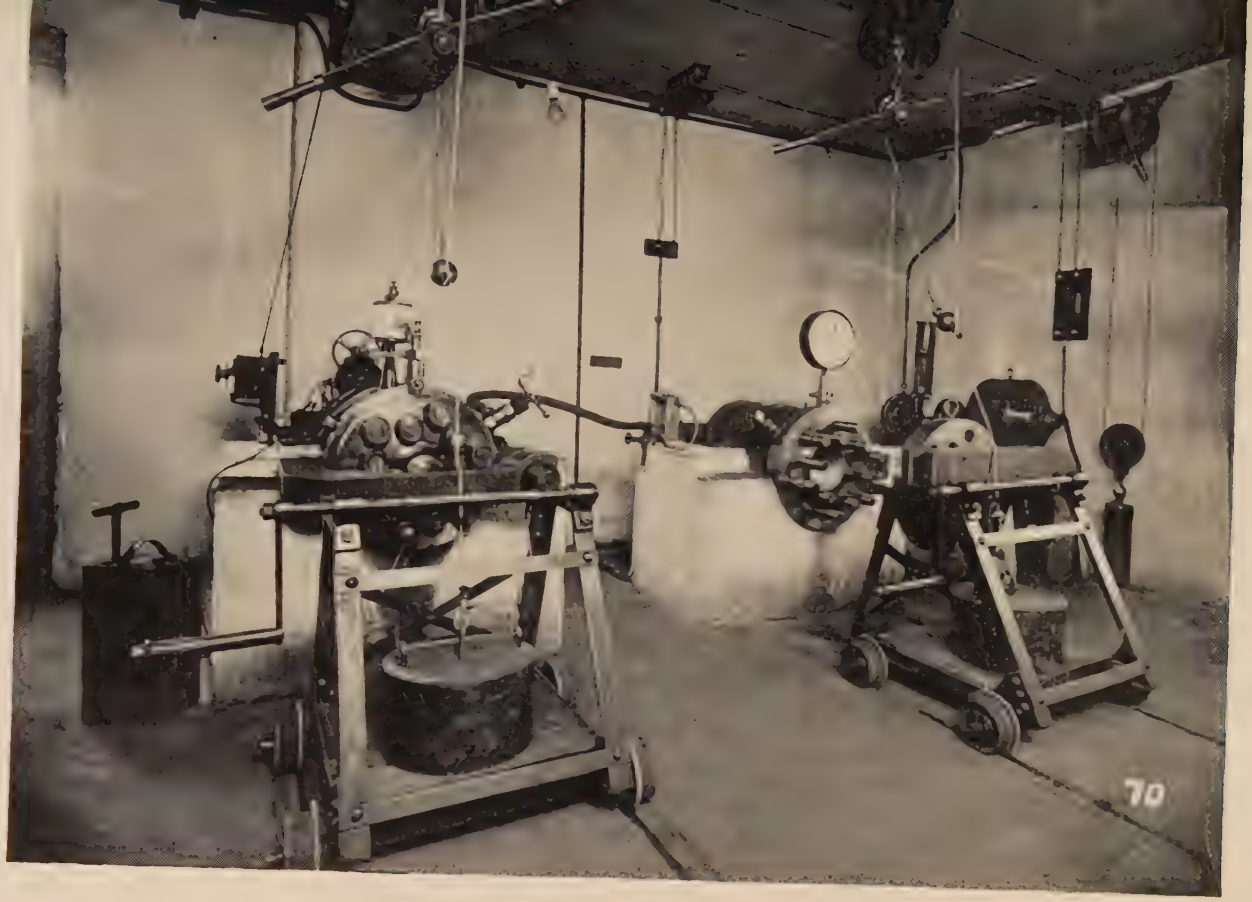


Fig. 8.—Bichel's Pressure Gages.

the chemical reactions taking place during the explosion are retained by the products of the reaction. Evidently this condition never actually obtains in practice, for a portion of this heat is always communicated to the walls of the enclosure. The portion thus lost from the products differs in amount with the temperature differences, with the rate at which the heat is set free in the reaction, with the materials of which the chambers are composed and the extent of the exposed surface in the chambers. Using chambers made of the same material it becomes possible, by varying the areas of these exposed surfaces in the different experiments to a known extent, to measure the heat-absorbing effect of surfaces of known area, and by combining this data with that recorded for the pressure, to ascertain the total dynamic effect of the charge of the explosive tested. This apparatus moreover affords a means by which the gaseous, liquid and solid products of the reactions attending explosion may be collected for chemical analysis and physical inspection and study.

In Fig. 8 are shown two of these gages, one of which is open and ready to load while the other is closed for firing. It will be observed that they are in principle like the bombs used by Noble and Abel in their Researches on Fired Gunpowder, but they are markedly developed in details of construction and in the addition of accessories. One of these cylinders has a chamber capacity of 15 liters, the other of 20 liters, but the volume of the latter may be reduced at will by inserting steel disks of known volume and area. The surface is thereby changed so that while the cooling surface of the small chamber is 3914 square centimeters, that of the large cylinder, when one large steel disk is enclosed, is 6555, and, when three of the smaller disks are enclosed, 7624 square centimeters.

These cylinders are made of steel 12.5 centimeters in thickness and the removable heads are secured in place by 12 heavy stud-bolts, packed with lead washers, and an iron yoke. A system of sheaves and suspended counter-weights is provided to aid in detaching the heavy heads from the cylinders and mounting them upon the specially designed wagons, so as to give ready access to the interiors of the cylinders.

Before the charge is fired the cylinders are exhausted to 10 millimeters of mercury. To permit of this being done a well-glanded tube is inserted in a perforation in an upper segment

of each cylinder near one end, and this is provided with a valve by which to isolate the air-pump after the vacuum has been attained. On the opposite upper segment of the cylinder from the exhaust a second opening is provided in which a glanded housing is inserted which affords a means for introducing the electric detonator and so packing its legs as to prevent air entering about them while the cylinder is exhausted, or gases escaping about them after the explosive has been fired and while a considerable pressure obtains within the cylinder.

A third perforation in the top of the segment carries a properly glanded tube provided with a piston 0.3937 centimeters in diameter which can move up and down within this tube. This piston is held on its seat by springs of known dimensions and effect. A stylus is mounted on the upper end of the stem of the piston in such manner that it moves freely only in the vertical plane, while the motor-driven drum at its rear, against which it impinges, rotates horizontally, thus producing a curve which, by its magnitudes and variations, records the extent of the pressures developed from the beginning to the end of the explosion.

The charge of explosive used varies from 100 to 200 grams according to its character, as judged by the results of the chemical analysis which has been made of it. The explosive is removed from its original wrapper and enclosed in a wrapper of tin foil in such manner as to preserve its original density. The head of the cylinder is removed, the No. 7 electric detonator passed through the glanded plug and then inserted and secured in the cartridge, the fused cartridge laid on a small wire support in the center of the cylinder, the head replaced, the vacuum produced, the indicator drum set in revolution, and then, all parts being found secure and operative, the charge is fired and the indicator diagram taken. Three shots are made with each of the different cooling surfaces.

After the explosion the products are allowed to cool to the room temperature which, with the tension of the gases, the barometer and the volume of the cylinder, is noted and the volume of the gaseous and vaporous products is reduced to normal. A sample of these gases and vapors is then drawn out through the exhaust opening and analyzed. The liquid and solid products are recovered, measured and analyzed after the head has been removed.

As is well recognized the heat developed by an explosive when

it explodes is one of the most important of the factors which determine its effect, and since Berthelot first employed the calorimetric bomb with which to directly measure the number of heat units set free by a known weight of an explosive, attention has been given to the improvement of this device so as to render it more useful. One of the modern forms of this instrument is Mettegang's explosion calorimeter which is shown in Fig. 9.

This consists of a bottle-shaped calorimetric bomb 30 inches high, with a capacity of 30 liters, made of wrought steel ½ inch in thickness, and closed by a cap having an air-tight fit. Two holes are tapped into this bomb on opposite sides of the curvature of the neck, into one of which a valve is tapped by which to connect the bomb with an air-pump, and into the other a plug through which the legs of the detonator are carried. This bomb, when charged, is placed in an immersion vessel, filled with a known weight of water, which is made of nickel-plated copper 1-16 inch in thickness, and which is strengthened by bands of copper wire wound about the outside. The immersion vessel is placed, with its contained bomb, in a wooden-insulating vessel provided with a wooden cover. The accessories consist of a framework stirring device, rotated or raised by an electric motor, with which to bring the entire mass of water to a uniform temperature, a thermometer with open scale reading to 1-100 of a centigrade degree, a magnifying glass with which to read this thermometer, a pair of scales on which to accurately weigh the several parts of the system and the water that is used, a hocking frame to raise the vessels from the scales and deposit them in place, and a machine with which to fire the charge.

The water equivalent of the calorimeter having been determined and the effect of the detonator and tin-foil wrapping having been ascertained, a charge of 100 grams of the explosive, wrapped in tin foil, is connected with a No. 7 electric detonator and suspended in the bomb, which is closed and exhausted down to 10 millimeters of mercury. The immersion vessel having received its weighed charge of water, all the parts of the calorimeter are assembled and the stirring device set in motion to bring the water, and therefore all essential parts of the calorimeter, to a common temperature. When the thermometer, immersed in the water, shows that a constant temperature has been reached the charge is fired and the rise in temperature recorded on the ther-

mometer carefully observed until the mercury has reached its greatest altitude in this experiment. From this data, together with that referred to above, the number of calories given by a known weight of the explosive is found.

In firing by detonation it is essential for safety and success in blasting that when the reaction is once initiated by the detonator it shall proceed throughout the column of explosive, for, otherwise, a portion of the charge may be thrown out of the bore-hole unexploded but inflamed, producing a "blown-out shot" which may ignite the fire-damp or coal-dust-air mixture, or a portion may be left in the bore-hole unexploded where it constitutes a source of danger in subsequent operations, or it may be brought down mixed with the coal to produce trouble in the breakers, in transportation, or in the use of the coal. The test employed to ascertain the relative sensitiveness of explosives to the detonation of masses of their own kind is called the explosion by influence test. I have applied this term to the testing of explosives for their sensitiveness to the initial detonation of a standard explosive, and described the method in the journal of the American Chemical Society 15, 10-18; 1893. A commercial method now used for sometime is one in which the cartridges are placed in rows on the ground, or other support, with spaces between each, and varying the intervals between the cartridges in successive trials. A more modern and severer test is to so bind two cartridges together with wire that they may be suspended vertically in the air, end to end, at a carefully measured distance apart, a detonator, of the grade recommended by the manufacture of the explosive, being inserted in the lower end of the lower cartridge, secured in place, and fired. By proceeding tentatively the distance at which detonation by influence ceases is said to be established within very narrow limits. For comparison between different explosives cartridges of uniform size are used, such as 1¼ inches in diameter by 8 inches in length. This may necessitate the repacking of the explosive, and when this is done care should be taken to preserve the original density, since this is a factor in this behavior of explosive.

While the explosive should be sufficiently susceptible to detonation to be fired with certainty it should not be so sensitive to percussion as to be dangerous in handling, transportation, or use. This sensitiveness of explosives to the effect of direct blows is

determined by the impact machine shown in Fig. 10, which consists of a vertical steel frame work carrying two guide rods between which a yoke, to which the impact weight or hammer is attached, is guided; an anvil upon which the charge of explosive is placed; and a soft-steel plunger which rests upon the anvil and upon which the hammer impinges in its fall. The yoke is provided with jaws which engage the lugs of an endless chain moving behind it, and by this mechanism the yoke, with its attached weight, is raised to any desired height. By means of an electric current the yoke may be magnetized and demagnetized at will, so that, when magnetized, it will attract and support the hammer to such an extent that both may be raised together by the endless chain to any predetermined height, at which point the yoke is demagnetized, the hammer, or weight, is released, and the latter then falls through the intervening distance and impinges upon the plunger. The stop which arrests the upward travel of the magnetized yoke and automatically causes its demagnetization is operated by a vertically driven precision screw on the right-hand side of the frame, which is also geared to a recording device which measures the height from which the hammer falls. By the aid of this screw and its accessories one is able to set the stop in advance, so as to secure any desired distance of fall for the hammer within the capacity of the machine.

The hard-steel anvil is set firmly on a heavy iron base and it is surrounded by a tubulated jacket through which water may be circulated so as to bring the temperature of the anvil, and of the charge of explosive placed upon it to any desired temperature and to keep it there. The plunger is held lightly in place by a steel guide which forms a part of the base support for the vertical-guide rods. It is essential that the faces of the plunger and of the anvil which are in contact should be absolutely true and plane. As the impacts and explosions produce deformation of the metal, the plunger is made of soft steel so that the deformation may accumulate on it, and therefore it is very frequently turned up on a lathe and reground to true up its face.

The hammer used weighs 2000 grams. The soft-steel plunger weighs 900 grams, and the maximum height from which the hammer can be dropped is 100 centimeters. The weight of charge of explosive used is 0.02 grams. The temperature of the anvil and the explosive at the time of testing is 25° C.

In making the test the explosive is weighed out on a chemical balance and the charge so wrapped in tin foil as to make a pellet in the form of a flat disk 1 centimeter in diameter. The hammer is raised, the stamp is lifted, the pellet is placed on the anvil, the stamp is pressed gently down upon it so as to insure a good contact, and the whole is left to attain the standard temperature. The stop is then set by judgment and the hammer raised until it is disengaged at the chosen height and falls upon the plunger. If no explosion ensues, the stop is set at a greater height and the hammer released, and this method of procedure is repeated until either explosion occurs on impact or the maximum range of the machine is reached. When explosion does occur the test is repeated with a fresh charge of explosive and slightly diminished distance of fall, and one thus proceeds tentatively until such a height of fall for the hammer is reached that there is no explosion, and yet if that height be exceeded by but 1 centimeter an explosion occurs. This point is then fixed by four additional tests giving the same results.

Provided all other conditions remain the same the brisant or shattering effect of an explosive varies with the velocity with which the chemical reaction, or explosion wave, travels through the column or charge of the explosive. Where explosives are fired by detonation this movement, as measured in definite terms of time and length, is styled the rate of detonation of the explosive. The making of such determinations is not new for Abel measured the rate of detonation in gun-cotton, nitroglycerin and dynamite nearly forty years ago,* and Berthelot did so some ten years later.† What has been done in recent years has been rather in the standardizing of the method, the improvement in the details and operation of the chronograph, and the introduction of the method into general practice.

To assure a definite and uniform area of exposure, the cartridges of explosives in their original wrappers, but with the ends cut off so as to avoid the damping effect of the layers of paper, are packed in tubes of thin sheet iron 42 inches in length and varying in diameter from 1½ to 2 inches, according to the character of the explosive to be tested. When the tube has been charged two copper wires are inserted through perforations in the

* Phil. Trans. 164, 377; 1874.
† Am. chim. phys. (6) 6, 556.

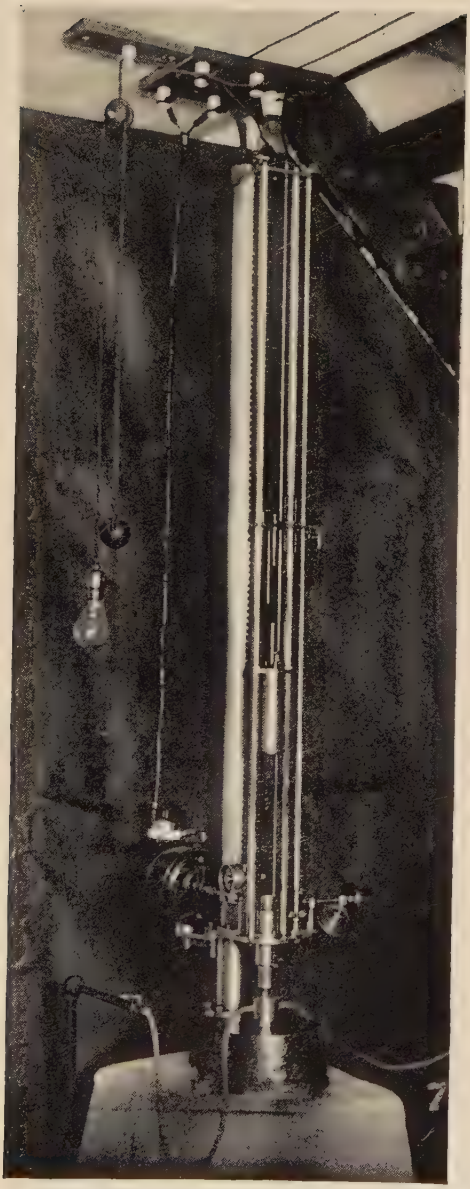
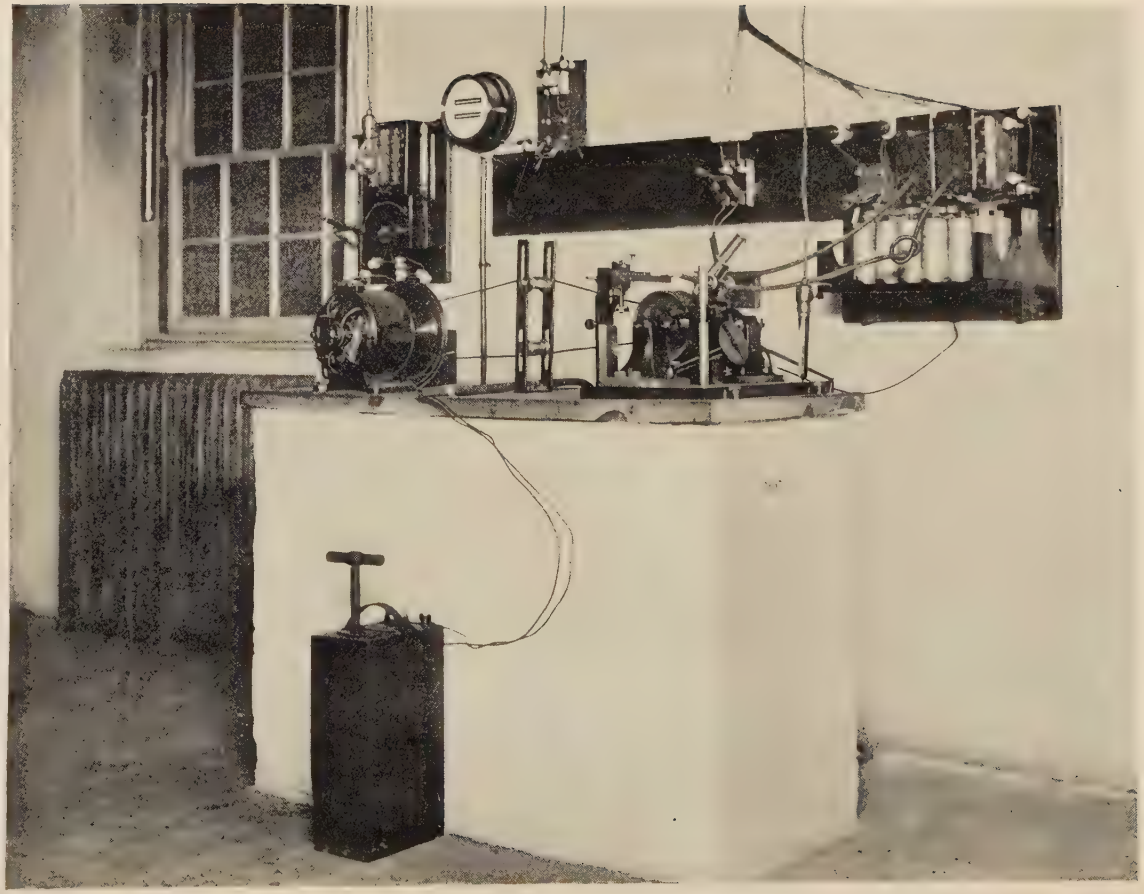


FIG. 10.—IMPACT MACHINE.



tube and the cartridge file at a distance of 1 meter apart, and these wires are separately led to a chronograph. An electric detonator of the usual type and grade is inserted in one of the end cartridges of the file; the tube, as now arranged, is suspended in the firing chamber; the copper wires which pass through the explosive are connected up to the chronograph; and the charge is fired.

The chronograph which records the time that elapses between the rupturing of the wire nearest the detonator and the wire 1 meter distant from it is known as a Mettegang recorder, and is shown in Fig. 11. The primary components of the Mettegang recorder are a soot-covered bronze drum so connected to an electric motor that it may be caused to revolve at any desired speed up to 105 revolutions per second; a 200-volt D. C. electric motor provided with a rheostat for controlling its speed; a vibration tachometer so connected to the bronze drum that the number of revolutions of the latter in unit of time are accurately measured for any speed between 50 and 105 revolutions per second; induction coils which may receive their electric current from electric-lighting circuits having terminal pressures of from about 110 to 220 volts; and platinum terminals placed about ¼ millimeter from the surface of the rotating drum, and in circuit with the induction coils, by which electric sparks are so projected against the surface of the drum as to disturb its sooty covering and produce a tiny bright spot at the point of impact, which spot may be easily perceived by the aid of a microscope attached to the drum.

The drum is 500 millimeters in circumference. The edge of this drum is provided with 500 teeth which may be made to engage an endless screw. A pointer attached to this screw passes over a dial reading to hundredths, and it thus enables one to read the distance intervening between the spots produced on the soot-covered surface of the drum with great precision. The drum is provided with six platinum terminals which are held by an insulated arm that may be so moved as to bring the points within any desired distance from the drum, and each one of these points may be put in series with one of the induction coils while the other end of the electric lead is grounded to the drum through the base which supports it. Only two of these platinum terminals are used in any single-firing trial for the determination of the rate of detonation in a given explosive, while the other four are held in reserve for future use.

To operate this method of ascertaining the rate at which detonation when once initiated is transmitted through a column, or file, of an explosive, the electric current which is used as the medium for transmitting the record is, as taken from its source, divided into two parts by passing it through two equal lamp resistances, each of which, at the Pittsburg Testing Station, consists of a series of five 16 c. p. lamps. These leads are then, after independently traversing the cartridge file at the initial and final points, jointly connected to one of the poles of the primary coil of the induction coil through which the current passes to the return conductor. The secondary coil of the induction coil is then connected by one pole to the two platinum terminals and by the other pole to the base supporting the drum as described. As is well known, in the induction coil any change of tension in the primary coil sets up an induced current in the secondary coil, and this mutual induction between the coils results in the production of a higher-potential difference at the terminals of the secondary one so that sparks of considerable length and intensity may be obtained.

The vibration tachometer, by which the speed of rotation of the drum is measured, is connected to an auxiliary shaft which engages the main shaft of the drum by gears, thus preventing any irregularity in recording the speed due to slipping. This tachometer measures the number of rotations of the drum, but as the circumference of the drum is accurately known, the distance which any point on the periphery travels may easily be calculated. Hence, at the highest speed of 105 revolutions per second, the distance of travel is 52.5 meters. At 50 revolutions it is 25 meters. At 86 revolutions, it is 43 meters per second. With this number of revolutions it is possible with this instrument to measure the ¼ 300,000 part of a second of time.

A more recent and simpler method of measuring the rate of detonation is that devised by M. d'Autriche,* which was described at the Congress in London, in 1909, by Dr. A. M. Comey, as follows:

The method of M. d'Autriche depends upon the use of a special detonating fuse having a uniform velocity of 6000 meters per second. A suitable length of fuse, according to the length of the column of explosive to be tested is taken for the test and the exact middle of the fuse is determined by measure-

* Comptes rend. *143*, 641 and *144*, 1030.

FIG. 12.—FLAME TEST APPARATUS.

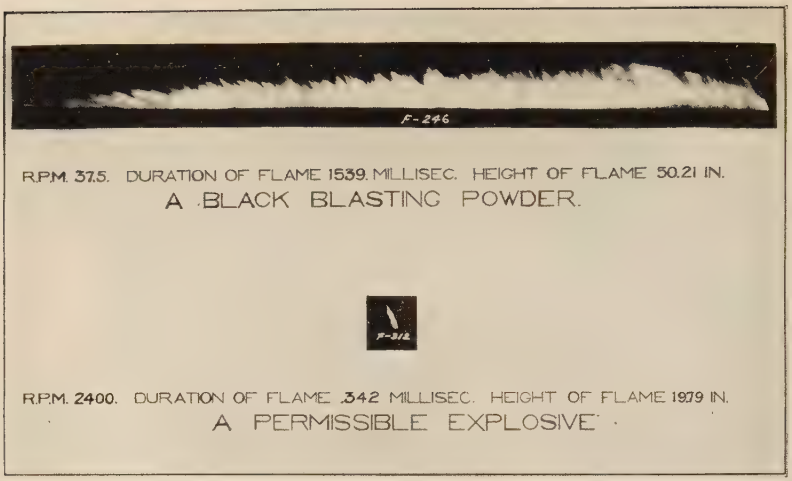

F-246
R.P.M. 37.5. DURATION OF FLAME 1539. MILLISEC. HEIGHT OF FLAME 50.21 IN.
A BLACK BLASTING POWDER.
R.P.M. 2400. DURATION OF FLAME .342 MILLISEC. HEIGHT OF FLAME 1979 IN.
A PERMISSIBLE EXPLOSIVE

FIG. 13.—FLAMES FROM EXPLOSIVES.

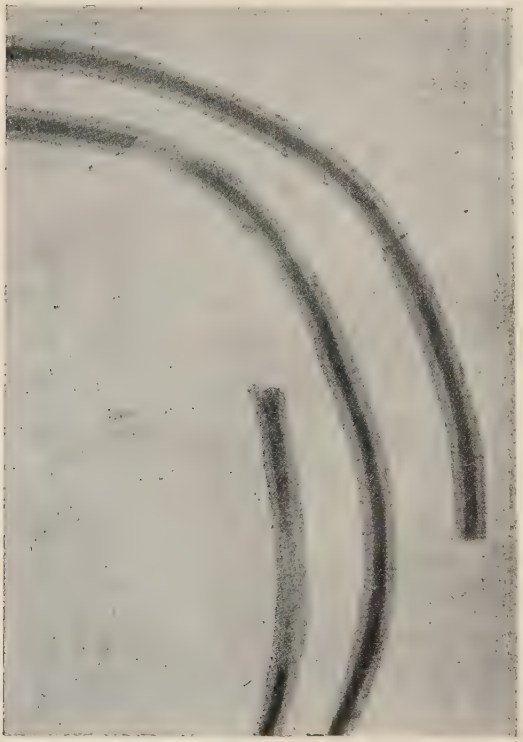


FIG. 14.—X-RAY PHOTO OF FUSE.

ment and marked. A fulminate cap containing a charge of 15 grains (1 gram) is slipped over each end of the fuse and crimped securely. The fuse is then laid upon a piece of 32-pound sheet lead (1½ inches × 15 inches × ½ inch) (38 × 380 × 13 mm.), so that the center of the fuse is about in the center of the sheet of lead, and the point coinciding with the middle point of the fuse is marked plainly on the sheet lead (M). The fuse passes along the entire length of the sheet of lead, and its ends are bent around so that they nearly meet. The two ends of the fuse covered with the detonating caps are inserted a short distance, at two points, into the column of explosive, the velocity of which is to be tested, and the distance between these points accurately measured. This may be called (A). A fulminate cap with fuse or electric connections is placed in one end of the stick of explosive. When this cap is detonated, the explosive wave proceeds through the detonating fuse in both directions and meets at a point (T) where a sharp line is formed by the effects of the detonation itself, and the lead is often broken through at this point. The distance from (M) to (T) is accurately measured and designated as (b). If the two ends of the fuse are detonated simultaneously (M) and (T) fall together, that is, the detonation proceeds at the same rate through the two halves of the fuse and meets at the middle, but when a certain length of an explosive is placed in the circuit we have on one side one-half the length of the fuse and on the other side one-half the length of the fuse plus a certain measured length of explosive. We have thus, letting,—

X = Velocity of detonation of the explosive tested.
V = Known velocity of the fuse (6000 meters per second).
A = Distance between two ends of fuse, or length of explosive tested.
b = Distance between M and T.

Then,—

$$X = \frac{VA}{2b} \text{ or } \frac{6000A}{2b}.$$

As to the accuracy of the test, it was found that by using the fuse alone (M) and (T) always coincided to within ⅛ of an inch (3 mm.). It is easily seen that errors in measurement will be diminished by increase in the length of explosive tested, and it can be calculated, with velocities of 4000 to 6000 meters per second, using 15 inches (38 cm.) of powder, that an error of ¼ of an inch (6 mm.) in measurement of the distance (M) to (T), which is a very large one under the conditions, introduces an error in the determination of the velocity of about 5 per cent.

Comey and his associates have tested this method quite fully at the Eastern Laboratory of the Du Pont Powder Co., and have found that it gives not only a ready and accurate means of determining the velocity of detonation through a column of any desired length of explosive, but that it is also possible by this method to determine the velocity with which a detonation wave travels through the air.

It is obvious that the flame-giving qualities of an explosive

plays a most important part in its liability to ignite fire-damp and other combustible mixtures, and that, all other conditions being equal, that explosive which gives the shortest flame for the briefest time is most suitable for use. Hence latterly much attention has been given to the study of the flames from explosives and many devices have been constructed by which to photograph them.

Among these is the one employed at the Pittsburg Testing Station where the flame is photographed on a moving film. The charge of explosive is fired from a "cannon," of the type used in the gallery tests, by means of an electric detonator or igniter, but in this test the "cannon" is mounted vertically in a concrete foundation at a distance of about 18 feet from the lens of the camera. To cut off extraneous light rays, so that the tests may be made at any time, the "cannon" is enclosed in an iron cylinder, 20 feet in height and 43 inches in diameter, which is connected with the dark room by a light-tight iron conduit, as shown in Fig. 12. The cylinder, or stack, is provided with a door in the side, through which the "cannon" can be loaded, and with a vertical slit, 8 feet in length by 2 inches in width, which is so placed that its vertical center coincides with that of the conduit and also with that of the lens by which it is viewed. At the time of firing the top of the stack is covered with black paper. The conduit is closed, at the point where it ends in the wall of the dark room, by a shutter.

The camera consists of a drum on which the sensitized film is mounted, an electric motor by which the drum is revolved at a known rate, a quartz lens, a semi-circular shield in which a stenopaic slit has been cut, and a shutter by which to control the slit in the shield. All of these, except the motor, are enclosed in a light-tight box. The semi-circular shield is placed close to and concentric with the drum to prevent any light reaching the film except that passing through the stenopaic slit. A lens of quartz is used because it focuses not only the visible light rays, but also those invisible violet rays which occur to a large extent in the flames from explosives.

By means of a tachometer both the number of revolutions per minute of the motor and the peripheral speed of the drum are directly read off. The maximum peripheral speed of the drum is 20 meters per second, and this rate is employed when detonating explosives are tested, but with slow-burning explosives

the drum is run at a slower rate. At the 20-meter rate 1 millimeter width of flame equals 0.05 milliseconds of time, and as the measurements of the flame photographs are read to the nearest quarter of a millimeter the smallest time interval measured is the 0.0125 milliseconds. The charge of explosive used in the test is 100 grams, and these charges are fired both with and without stemming.

The results of this test on black-blasting powder and on a permissible explosive are shown in Fig. 13. By the term permissible explosive is meant an explosive which has satisfactorily passed all the prescribed tests at the Pittsburg Testing Station, and is regarded as suitable for use in coal mines.

One of the most novel of modern tests is that devised by J. Thomas,* who has employed the X-rays for ascertaining the condition of the powder core in Bickford or running fuse. The cause of misfires and delayed ignitions has been the subject of much speculation, and among other theories proposed was that of a break in the continuity of the powder cores. In Fig. 14, which is a copy of Thomas' X-ray picture, the interruption of continuity in two pieces of the fuse shown is very apparent.

* J. Chem. Met. Soc. S. Africa 9, 183; 1908.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE ORGANIZATION OF THE FLEET.

ADMINISTRATIVE: TACTICAL: FOR WAR.

By Captain John Hood, U. S. N.

Any one who has given much thought and study to the existing organization of our fleet as laid down in the Tactical and General Signal books, and provided for in Naval Regulations, has undoubtedly observed many lacks and deficiencies in our system from an administrative and a tactical point of view, as well as some illogical cumbersomeness, misuse of terms and unpreparedness for war of the fleet as a whole.

The system would appear to have grown up in a conventional kind of way from circumscribed ideas drawn from the consideration of our former small and insignificant naval forces, with insufficient thought given to the welding of the various component parts of a naval force into an organized whole, and resembles to some extent a palace built about a hovel in which the parts of the palace have been made to conform in architecture and general plan of the original hovel.

Now that our fleet has grown to be a fleet in fact as well as in name, it would seem that an organization founded on the broadest views for administrative and tactical efficiency, and designed for automatic expansion of the fleet in war should be adopted, and old forms and conventions applicable only to the weak and unimportant forces of the past should be dropped and forgotten. In other words, let us build our palace on new ground with the best architects and designers, with a view solely to its completeness and perfection, and without any consideration for the hovel it was designed to replace.

There is yet a further fact coming from this clinging to obsolete forms and ideas in our present organization that leads to confusion and misconception, and is inimical to proper organization which means efficiency. This is the confusion of titles in, and subdivisions of, the fleet.

In former years when our few inferior ships were distributed about the world in stations, we had "commanders-in-chief" scattered over the face of the earth, commanding "squadrons" varying from one to perhaps half a dozen vessels of indiscriminate sizes. Of "fleets" we had none. Thus it came about that the grand title "commander-in-chief" became corrupted, and was used to mean the commander of any independent force from one vessel up, and totally lost its distinctive and true meaning, that of the commander of fleets. Similarly the terms "squadrons" and "divisions" became confused; and "squadron" having been used to designate in the days of our naval decadence the independent forces scattered about in stations, and being the nearest approach to anything we had in the way of organized naval forces, became to be considered as coming next to the "fleet," and so became a component part in the fleet organization as laid down in the books, and lost its original and true significance, which had been from the earliest days of sea history a term used to designate a small number of ships under one command.

Having accepted this corrupted meaning of the word "squadron," and thus raised it to the dignity of a wing of the "fleet," we saw that a further subdivision of the enlarged fleet was necessary both tactically and administratively, and introduced the "division" to meet the need. Here we have, by our patch work construction, arrived at a confusion of terms, peculiar to ourselves, which makes confusions in our organization worse confounded, and likewise in the titles of our junior commanders under the commander-in-chief.

Why not retain the time-honored word "squadron" in its original meaning, and make it the basis or unit of our fleet organization, and use the word "division," when it becomes necessary, in *its* true meaning to mean a "division of the fleet?"

In the scheme of organization which will be proposed, the terms "squadron," "division" and "fleet" will be used in their true meanings, though it is immaterial to the plan whether we accept these definitions, or retain the terms used in our present books, calling the basic subdivision of the fleet a "division" and next larger a "squadron." Throughout the discussion there would only be a change of names to conform to present convention rather than to the true meanings of the words, and this will in no way affect the working of the scheme.

Of the three it will be seen, as the scheme is developed, that the

"squadron" is the unit and the only *fixed* subdivision in the organization; the "division" being made up according to circumstances, the available forces, and the requirements of the time, of a variable number of squadrons; and the "fleet" of "fleets" of the available number of "divisions."

With these subdivisions, the titles of the various commanders, as also their duties and commands, become clear and distinct. A "fleet" should be commanded by an admiral, commander-in-chief; a "division" should be commanded by a vice-admiral, division commander, a "squadron" should be commanded by a rear-admiral, squadron commander.

Experience in our own fleet—and it is believed that this is borne out by similar experience in foreign fleets—has shown that one commander cannot properly inspect and care for in all their multitudiness and multiform administrative details a greater number of ships of the line than four. With a greater number than four of such vessels under the immediate command of one man, incomplete or negligent inspections must result; and delays or confusion, or both, occur in the administrative details of the whole or part.

This has proved to be the case in practice, and hence may be accepted as an established fact, and goes to show that the *administrative* unit of the fleet should consist of not more than four vessels of the first class, which unit should be called by its rightful name, the "squadron," and should, for administrative purposes, be the basis of our fleet organization.

There are many tacticians who, even now, advocate the reduction of this unit from four to three, but this rather for tactical than administrative reasons. With the rapid increase in the sizes of battleships projected at the present time, with a corresponding increase in the administrative needs and cares of the individual units of the squadron, reasons of administration as well as of tactics may not unreasonably be expected in the near future from the advocates of the three-ship squadron organization.

If experience in our own and other fleets has shown that for administrative purposes the fleet unit of four vessels—which has been called the "squadron" in this article—is the best subdivision for the basis of our fleet organization, experience from the same sources will prove that it is also the best for tactical purposes, though, as remarked above, some tacticians prefer a basic unit of three. The greater the number of ship units in one

tactical unit in compound formations the more inflexible the formation, and the greater the time required to change from one formation to another. As flexibility and time are the greatest considerata when maneuvering in the face of an enemy, the tactical unit must necessarily be such as to give the greatest value to these two primary considerations without unduly weakening the unit. To carry the reasoning for flexibility and rapidity of movement to its ultimate conclusion would reduce the fleet unit to the single ship; but this is inadmissible both from its inherent weakness from lack of leadership and organized support, and from want of cohesion. The same applies to a fleet unit of two, and, to a less extent, of three, while with four cohesion and leadership are attained, without undue sacrifice of the flexibility and time elements. With any greater number than this in the fleet unit, the sacrifice of both flexibility and time becomes increasingly greater without corresponding increase of strength and cohesion.

This has proved true in practice and maneuvers, and hence it may be adduced that tactically—as well as administratively—the "squadron" of four is our best fleet unit at the present time on which to base our fleet organization, though later productions of larger and more formidable vessels may reduce this unit to squadrons of three. Should this occur, it will in no wise effect the organization of the fleet, hereinafter indicated, as a whole.

If the foregoing reasoning is correct, our first step in the organization of the fleet would be to form the ships of the line into squadrons of four vessels each, each squadron to possess ships of as nearly similar tactical qualities as our heretofore heterogeneous building programme will permit—but above all the same speeds—and these squadrons to be organized into complete, independent administrative and tactical units, each under its own commander.

The units having been formed, next will come the "divisions of the fleet."

The number of these will depend upon the number of battleships in commission and the number of squadron units which is decided as best to place under one command. On this latter question there has been much division of opinion, but the better reasoning would appear to be that the size of this division of the fleet should be limited to the number of vessels that one commander can control and handle in battle. This number has been variously estimated by different tacticians from eight to sixteen.

Eight is undoubtedly small, and forms a weak division, while a majority of opinion that seems to be of most weight hold that sixteen ships of the line in one formation is more than one commander can properly lead and control in action. Our own service opinion—which is supported by English practice—seems to be crystallizing on a number between these two, varying from nine to twelve. This latter seems to be just, and supported by the better arguments; and since it cannot be questioned that the logical "division of the fleet" should be composed of that number of vessels which one man can lead and control in action, what might be called the *fighting* unit of the fleet, as distinguished from the *tactical* unit, this division should consist of *three* squadrons. This, with our present fleet would give twelve ships of the line to the division; though later, with the larger vessels in contemplation, necessitating a considerable lengthening of the line per vessel, this number might be reduced to nine with these larger vessels, the three squadron organization being retained.

The commander of a division of the fleet should be a vice-admiral, and both for simplicity of organization and the dispatch of administrative business, it would seem best that he should also be the immediate squadron commander of that squadron of his division in which he chooses to fly his flag, and that the other squadron commanders should have direct access to him without any intermediary.

Accepting, then, the division of the fleet as defined above as the fleet *fighting* unit, their number would depend solely in the number of ships of the line we would keep in commission. With the ships we have already built, and these to be completed in the very near future, we should form at least two such divisions for the active fleet in commission at once; and as the fleet increases in the future, new squadrons and divisions should be formed of similar types of new ships, and the fleet increased from time to time by a new division, a division of two squadrons being formed when there are not yet three completed and available.

These divisions should be complete, independent entities designed to act independently or in concert, but rarely if ever more than one in a single line of battle, though cases might arise when two would so act. It is hardly conceivable, however, that three or more such divisions ever should or would be brought into a single line of battle.

Having now formed the administrative and tactical unit of the fleet—the squadron—and the fighting unit—the division of the fleet—we come next to the fleet itself.

The word "fleet" as applied to navies in its broadest sense, means the combined fighting sea force of the nation. In a more limited and generally accepted sense, it means a very large fighting sea force, greater that the *fighting* unit, under *one command;* as when necessity or expediency compels a nation to separate its sea forces into two or more parts which from their geographical situation and fields of action cannot act in conjunction with each other, further than to attack the enemy each in its own field, and hence must be independently controlled and commanded, and thus form separate fleets in this limited sense of the word.

Such will be our own case, should we have war in the Atlantic and Pacific at the same time, and our necessities would compel us to form fleets, in this limited sense, in both oceans. Many similar cases will arise in the case of any nation having very large naval forces compelled to act over wide fields of action, and with extensive and important interests in widely separated portions of the globe.

Since our ideas concerning the organization of the fleet should spring from the conditions which are likely to arise in war, rather than from theoretical ideas of the definition of a word, our plans of fleet organization should be founded the reason of existing conditions, and the meaning of the word "fleet" in our organization should be taken in its limited sense. That is, a "fleet" in its tactical sense, as defined in fleet organization, should be any two or more fighting units—divisions—placed under one supreme command and operating in one field of action, whether united in one body or acting in concert, under one commander, who should be known as the commander-in-chief, and have the rank of admiral.

The suggested organization seems simple and logical in the extreme, and permits of unlimited and natural expansion of the fleet without jar or confusion, defines duties, places natural organizations in their natural sequence under their proper name; first the tactical and administrative unit—the squadron—next the fighting unit—the division—and finally the sea power of the nation—the fleet or fleets. It further defines titles and places rank and control in natural order, and gives to the much abused and misused title of commander-in-chief its only real and true

meaning; viz., the commander of a *fleet,* or one who in reality commands in chief, and *not* one who commands a subdivision.

As previously remarked, the only *fixed* quantity in the suggested organization is the administrative and tactical unit—the squadron. It is suggested that the best organization for the division is three squadrons, following what has seemed the weight of opinion. This, however, is not necessarily fixed, the only governing principle being that the "division" *should not be larger than one commander can bring into action and control in one line of battle.* As noted, opinions vary in this point, and other circumstances might sometimes make it advisable to form a division of two squadrons, or of four squadrons; but this does not affect the principle or vary the system of organization.

A fleet may consist of any number of divisions from two up that it is deemed advisable—taking into consideration the theater of war, the situation of the enemy or enemies and our own resources—to place under one commander-in-chief.

So far as the argument has proceeded reference has been made only to ships of the line, which form the backbone of the fleet, and the real fighting sea force of the nation. All other parts of the fleet, cruisers, scouts, destroyers, auxiliaries, etc., while necessary and important and a component part, are adjuncts to the fighting fleet, and their organization should be made subsidiary thereto. Therefore, first consideration has been given to the organization of ships of the line of battle, and that of the remainder of the fleet follows naturally therefrom. All the reasons given for the formation of the battle line into independent, administrative and tactical units—the squadrons—apply equally well to all the lesser components of the fleet, only from the smaller sizes and uses of some of them a variation in the numbers composing the squadrons is permissible and advisable.

In the case of the larger armored cruisers of the fleet the same rules would apply as in the case of battleships; but in the case of smaller cruisers, scouts, destroyers, torpedo-boats and auxiliaries, it would probably be better to group them into squadrons of a greater number of units, according to their sizes, class and uses, and groups of six are suggested as the best number to form the administrative and tactical units with all these classes of vessels, except auxiliaries.

That is, armored cruiser squadrons should be formed of the same number of vessels and in the same manner as the squadrons

of the ships of the line, and from their size and importance each such squadron should be commanded by a rear-admiral. Scouts, and smaller cruisers which can be used as scouts, should be formed into squadrons of six vessels each, grouped in like classes, and each squadron commanded by a captain. Destroyers should be grouped by class in squadrons of six, and each squadron commanded by a lieutenant-commander, except as hereinafter indicated. Fleet auxiliaries grouped in larger squadrons—one for each division of the line of battle—each squadron consisting of six colliers, two supply ships, one ammunition ship, one distilling ship, one repair ship, and one hospital ship, making a squadron train of twelve auxiliaries for each division of the fleet, commanded by a commander.

With the tactical and administrative units of the fleet adjuncts thus formed, the next step is to assign these units to the fleet, in the manner best designed to complete the most efficient and simplest fighting organization of the whole.

In the general plan suggested in this paper, the division of the line of battle has been made the fighting unit of the fleet, and it is on this basis that the assignment of the other units should be made.

Assuming the division of the line to consist of three squadrons of battleships or twelve vessels, the question is, how many of the various classes of other vessels should be attached to this command to complete it as an independent fighting force? Both practice and theory on this question has been very varied, the ratio of armored cruisers, scouts, destroyers and auxiliaries to battleships in a given force being variously estimated in our own conferences on the subject, and differing widely in the practice of other nations. In considering it, and coming to the conclusion given below, attention has not only been given to what would be ideally perfect, and what has been written on the subject and the practice in our own and other services, but also to what is practicable with our present resources and what is probable in the way of accomplishment in the future.

With our existing fleet, to each division of the fleet should be attached one (1) squadron of armored cruisers, one (1) squadron of scouts (or cruisers that can be used as scouts), two (2) squadrons of destroyers, and one (1) squadron of auxiliaries.

A complete division of the fleet would then consist of twelve battleships, four armored cruisers, six scouts or cruisers, twelve

destroyers and twelve auxiliaries. This, it is understood, is only a beginning, to organize the material we have already in hand or building. For a completed division, when our resources of material will permit, the armored cruisers should be increased to two squadrons, the scouts to two squadrons and the destroyers to at least four. This would make a completed division of twelve battleships, eight armored cruisers, twelve scouts, twenty-four destroyers (which should be increased to forty-eight when Congress can be induced to build them), and twelve auxiliaries under one command, forming a complete fighting unit; and, it may be observed, that the increase to the full force can be made without jar or confusion to the organization, simply by adding the extra tactical and administrative units of the adjuncts to the main body as they become available.

In such a division organization command is natural and logical. The vice-admiral commands the whole, supported in the line by his junior squadron commanders. The rear-admiral of the armored cruiser squadron commands and supervises the scouting line and screen. The senior squadron commander of the destroyer force should be a commander exercising command and supervision over the divisional destroyer force. The divisional train, in charge of its commander, would move as directed by the fleet divisional commander.

As previously indicated, the fleet or fleets would be formed by the joining of two or more such divisions under one command—that of the commander-in-chief—as the exigencies of the service for practice in time of peace or the national interests in time of war would dictate.

The plan for the organization of the fleet briefly outlined in the foregoing remarks, seems to be simple, logical, easy of adoption, and to be founded on reason instead of convention; and it is believed it can be put into effect without jar or confusion, and with few changes in the Signal and Regulation books, and that its adoption would lead to the greatest efficiency of the fleet administratively, tactically and for war.

Before closing this paper, it would probably be well to offer a few remarks on the much mooted question of the position of the commander-in-chief in the fleet, and also to mention certain necessary fleet auxiliaries that have not been specifically assigned to the divisions.

While it is the firm conviction of the writer that in any single

line of battle, such as is contemplated in a divisional action, the commander of the line engaged should be of that line and lead it, the commander-in-chief of a fleet occupies a different position. Rarely, if ever, will he bring his whole fleet into action in a single line of battle, nor could he control the whole line if such an eventuality should ever occur. His function is to overlook and direct the operations of his fleet in the whole theater of war; trusting mainly to his subordinates to carry out his plans and operations and actually lead in battle, after having instilled into them his plans and ideas of the campaign, and always keeping them in close touch with any changes contemplated by him in his plan of operations. To accomplish this it would seem better that he did not attach himself permanently to any one division of his fleet as a component part of it, but direct the operations from some central position, or convenient center of information or communication. This line of reasoning leads directly to the conclusion that the commander-in-chief's flagship should be independent of his divisions, and that he will naturally attach himself to whichever division of his fleet he considers best from which to direct his whole operations, which will usually be the division occupying the central position in the operations. When whole fleets are actually engaged in battle, history tells us that all great naval commanders have usually given their personal command to the center, leaving the van and rear to the leadership of their subordinates.

Finally, regarding the matter of certain auxiliaries which are necessary to the fleet and form part of it as a whole, but have not been attached to the divisions in the plan as outlined, it may be said that these auxiliaries are few in number, and rather of the *fleet* than the *division*. These consist of mine layers, cable ships and tugs. These are few in number, and needed only for special service, and do not of themselves form a component part of a fighting unit, though necessary to the fleet as a whole. They should, therefore, be classed by themselves, and will at the direction of the commander-in-chief, be attached from time to time to whatever division of the fleet he has directed to carry out operations which need their special services.

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NOTES CONCERNING THE ORIGIN OF SOME OF THE INSTITUTIONS OF THE BRITISH NAVY.

By SURGEON A. FARENHOLT, U. S. Navy.

"Those oaken giants of the ancient race that ruled all seas."

The bearing and example of British naval development and progress, has, especially during our formative period, exerted toward our public sea service a naturally marked influence. The common tongue, the unrivalled supremacy of the Royal navy, the absence of existing naval traditions, the example afforded by the presence of the King's ships in our ports during colonial days, the interchange of social amenities and the fact that many of our young men had taken service in those ships, notably Nicholas Biddle, who had served as a brother midshipman with Nelson, rendered it but natural that this influence should be felt and respected. It is on account of this intimate relation to our service that these notes, necessarily meager in an article of this length, concerning the origin of certain customs, names and manners, may prove to be of interest.

Nomenclature.—As early as A. D. 700 the Saxons employed vessels called *hulks;* the term *barges* dates from about 1000. These, as well as all vessels of the early days, were steered by a wide-bladed oar worked over the *starboard,* "steer-board," quarter and were fitted with *fore, aft* and *top castles.* By the year 1250 we hear of *ratlines, polyves* (pulleys) *sheeves, swivels, stays, backstays, hawsers, cables, sheets, yard ropes, bowlines,* sundry *lines* and many other well-known words. The terms *lighters, hock boats*—identified by some with the modern word "hooker"—*helm,* ship's *junk, blocks* and *tacks* were used before 1400. About this time ships had *capstans* and *rigging,* and were calfacted, or caulked, with tow and tallow. In 1515 the *Harry Grace*

à Dieu carried *foer, mayne, mayne mizzen,* and *bonaventure masts.* The term *frigate* was common in the days of Sir Humphrey Gilbert, and Raleigh speaks of the *overloop,* "orlop," of "striking top masts," and of *bilges;* at this time ships were ordered to "follow the motions of the flagship," and to "make the best of their way." Under King James I, we read of *flush decks, tyres of guns, quarter* and *half decks,* and by this time it may be said that fully two-thirds of the fittings of a modern sailing ship were known by the names they bear to-day.

Construction.—Although during the crusades the size of many vessels sailing in the Mediterranean was sufficient for the carrying of 800 to 1000 persons, it was not until the 15th century that ships of that size appeared in the stormy waters around England. Galleons, galleys and cogs made their appearance in order about this time. In 1450 the shield row, used to give protection to the men about the deck, began to give place to a solid bulwark pierced with circular holes for the archers; these became larger when required for the use of guns, and in 1670 were abandoned for square ports, allowing greater angle of fire.

The early single square sail gave way to three, and, by stages, to three masts with three square sails on each, royals not coming into common use until the beginning of the 19th century. The use of guns on covered decks lower than the upper began early in the 16th century; for many years to come, however, the great guns were almost a secondary consideration in the conduct of sea fights; a single discharge from each gun was customary, the brunt of the conflict being born by hand-to-hand fighting. Up to the 17th century the unit of measurement was the tun cask of wine; the tons or "burthen" of a ship being the number of tuns she was able to carry. This system continued until Charles II's time, when it gave place to the following rule: length x beam x depth of hold, divided by 100. This was changed during the reign of George III to length x beam x half beam, divided by 94.

During the 17th century the high stern castles had become lower, resolving themselves into the poop with one small cabin and deck above. Below this was the quarter deck, running only to the mizzen and being literally one-fourth of the ship's length; below this was the main, later the spar deck, extending to the foremast, and beyond this was the forecastle, on which in early times was raised the topgallant forecastle. The sides becoming

higher and higher to keep out the sea, light fore and aft rail gangways appeared, to facilitate passage between the ends of the ship, and soon the space between was covered with spars and gratings, thus forming the "spar" deck. About this time permanent hammock nettings above the rails took the place of the old canvas screens formerly used to protect the fighting men in the waist.

Hammocks themselves were first used in 1599, and in 1629 we find them only issued to ships on foreign stations. Two men shared each hammock, one man being constantly on watch.

The customary protection for vessel's bottoms in early times was the application of a compost of tar and hair held against the ship's side by light planks; outside this was often coated a mixture of tallow, soap or brimstone. For over one hundred years vessels' bottoms were "filled" with broad-headed nails hammered close together, paid over with tallow and resin. Lead sheathing was first used, by the Spanish navy, in 1514. The English merchant marine used it extensively after 1560, but it was not until 1610 that it was employed on government ships. The first use of copper for this purpose occurred in 1761, when the bottom of the *Alarm* was so treated. Galvanic action with the pintles of the rudder delayed its general adoption for many years. It was finally ordered for all ships in 1783, but later Howe and Nelson complained bitterly of the slowness of their uncoppered ships.

Lightning conductors were first recommended by Lord Anson and issued soon after his death in 1762. They were, however, only ordered to be set up on the approach of a storm and were not permanent fixtures, in consequence of which much loss of property occurred. The first chain cables were ordered for use in 1811; before that date hemp hawsers were employed, the standard sizes being 22, 20, and 8 inches. Iron water tanks took the place of the old wooden water casks, and pig iron ballast of sand and gravel, during the 20's of the 19th century. Up to the time of the Commonwealth the pinnace and the skiff were the only boats habitually carried. The "long boat" appeared at this time but was never hoisted in. When under weigh it was towed astern. There were no davits as we know them until after 1811, tackles on the main and foremast shrouds being used for hoisting in and out boats and heavy weights.

Personnel.—A recent publication of the British Naval Records Society states: "Every one who has paid any attention to the subject, knows how curiously ignorant we are as to the social life or social status of our forefathers in the Navy; we do not know where or how they lived, messed or dressed." Not only is this true of the British service, but also surprisingly so of our much more youthful navy.

Many of the titles of officers who served in the early ships sound oddly to-day. Edward the Confessor's ship in 1206 was commanded by a "rector," a term which lasted until late in the 13th century, when the word "master" began to be used. The master was attended by a gromet, a groom or boy. The batsuen, "boatswain" or husband, and the "cog swain," master of a cog or cock boat, were of great antiquity. The "armorer" had charge of the men's fighting gear and armor, and the "fletcher" made and repaired arrows. The title of "admiral" was originally a French one and pertained to the army; it was first used by the English about 1300; before that time the commander-in-chief was variously known as "leader and governor," "leader and constable" and "justice." Chaplains and surgeons appeared in the fleet about this time. The clerk or burser, later "purser," the "captain' and the "carpenter" came shortly after; the carpenter's title is said to have been originally confined solely to woodworkers afloat and those who had to do with ship work, their brethren ashore being called "smiths." The gunner in early times was a person of considerable importance, he lived aft while the other warrant officers lived forward, he had charge of the gun-room and, somewhat later, had jurisdiction over the midshipmen. He was assisted by the armorer and the gunsmith, both warranted. In the 16th century we hear of the schoolmaster, who messed in the gun-room and was also a warrant officer. The "swabber" at this time was an important personage; he was what we would call a petty officer, was responsible for the cleanliness of the ship above the water line, both within and without, and was answerable for the personal cleanliness of the crew. In his efforts to keep the ship sweet he was directed to "burn pitch and such other wholesome perfumes between decks." The "trumpeter" was a warrant officer who was to assist in affrighting the enemy by his "noises," he disappeared about the middle of the 18th century. At this time we first hear of the master at arms;

originally he was, as the name implies, an instructor in small arms, thus taking over the duties of the corporal, a 17th century functionary whose office had become obsolete. With the master at arms came the ropemaker, a subordinate warrant officer directly under the boatswain. Yeomen, having charge of storerooms, were first met with about 1750.

In 1580 lieutenants first appeared at sea and they are known to have served in the actions against the Armada, but the grade almost died out, later being again established in 1650. At first the single lieutenant was but an aid to the captain, later taking over the details of the ship's internal economy; then followed a period when two lieutenants were carried, the second being given charge of gunnery and musketry. As more lieutenants were added they became, naturally, divisional officers. Until quite modern times the details of navigating were left to the master's grade. The early pursers were not paymasters, as we know them, until well into the last century. Pay for officers and men was distributed very infrequently and was, by a complicated system of tickets, disbursed by clerks from the navy office. The purser's duties were those of an official and private storekeeper. He transacted the government business by ship's money or bills of exchange, issued ship's stores and slops, and was allowed to sell articles carried by himself. He was also to muster the crew every ten days.

The earliest midshipmen were so designated in 1643, they were but "ship's boys," retainers of the captain, and often also served in the capacity of servants. A class of volunteer boys, a sort of naval apprentices, were called "naval cadets" for a few years subsequent to 1844. The title of sub-lieutenant was created by Lord St. Vincent in 1802; in 1830 it had nearly died out, but in 1864 it was substituted for that of mate and became, as now, a grade between lieutenant and midshipman.

The term "petty officer" appeared first in 1808. In early times the purser, gunner, carpenter, boatswain and cook were called "standing officers," or "warrant officers of higher rank." These officers had charge of a vessel when she was laid up, as until recently were all ships during the winter. The standing officers received their warrants from the Admiralty; and the surgeon and master, who were called inferior officers, from the navy office. All were, however, classified as "civilian officers."

By the regulations of 1808 masters, surgeons, and pursers were to be called "warrant officers of ward-room rank," thus being separated from gunners, boatswains and carpenters. In 1843 these officers, and the naval instructor, who appeared in 1837, were "transmuted" into commissioned, from warrant, officers.

The first appearance of a permanent corps of sea officers was in 1417, but comprised only a few subordinate ranks. It was not until after the Armada that following the sea became a profession with higher officers. About this time the amateur officers and court favorites were very gradually replaced by trained "tarpawling" seamen, although for almost 150 years such professional seamen as Drake, Hawkins, Penn and Frobisher were to be found in the same service with gentlemen captains and army officers, as Grenville, Effingham, Seymour, Blake, Monk and Torrington.

Up to 1667 all higher officers, admirals, captains, lieutenants and others, were discharged whenever a vessel was placed out of commission, only a few subordinate officers remaining on board as ship keepers. In 1674 the Admiralty ordered that certain officers should, while unemployed, receive half pay. This really marks the establishment of a permanent naval force.

While in times of war commissioned promotion was always sufficiently active—for example, Nelson received his post rank 9 years after his entry as a midshipman and in his 21st year—it is interesting to note that it has not always been so. After 1815 the average age of all officers became much advanced. Many captains remained over 20 years in the grade. One officer was a commander for 47 years, a lieutenant is known to have remained in the grade for 60 years, a master for 61 and a purser for 64. In 1841, 200 commanders and 1450 lieutenants had received no promotion for 26 years or more. This resulted in the employment of officers of advanced age. Admiral Bowles was 79 when he took command at the Nore and many flag officers were afloat at 73. During the 60's steps were taken which remedied this situation.

Of the early seamen who simply navigated their vessels for the convenience of the soldiers, the fighting force on board, we know but little. Early in the 16th century this method of manning and fighting a ship began to be modified. The *Great Harry* in 1512 carried 349 soldiers (musketeers), 301 mariners, and 50 gunners. As she mounted 70 guns, it is to be supposed that she manned but

one battery at a time. In 1558 the *Victory* carried but 100 soldiers and 268 sailors, and before the end of the century the soldiers disappeared entirely, to be only occasionally seen again except as marines.

Men were hired for the week, month or particular service until long after the Armada. We know that the enlisted men of the 16th century were not all that could be desired. The crew of the *Mary Rose,* a vessel lost in 1540, were described as "a sort of knaves who so maligned and disdayned one the other, that refusing to doe that which they should doe, they were careless to doe that which they oughte to doe, and so, contending in spite, perished in frowardness." At the end of the century they were spoken of as "a loose rabble," "vagrant and lewd," and "a ragged regiment of common rogues."

Impressment, from "imprest" money paid at the time of enlistment, dates from the year 1355 and continued in force until the peace, 1817. At all times, however, men were taken on voluntary enlistment. This method of manning the fleet has not always been the inhuman and iniquitous procedure of which we are told. In past times it has often been an absolutely essential evil. There was also a land "press" used by the army. The character of men obtained in this manner until the latter part of the 18th century was very good. At that time, however, the number of men needed for the navy was much greater than could be obtained by the two existing methods. To stimulate enlistment large bounties were offered and the various shires and cities were given a quota to furnish: the result was the gathering together in the fleet of a large number of highly unsuitable men. Jailbirds, vagrants, weaklings and offenders about to be sentenced for crime were sent to the ships in great numbers and in a short time worked infinite injury. The harsh discipline and the notorious mutinies of the last years of the century were in great measure due to this.

In 1849 good-conduct medals were first given and in 1852 a system of continuous service was established. Before and during the days of the Commonwealth there was little dissatisfaction as regards pay, but from that time until the beginning of the 19th century there was much cause for complaint. The men and the government were systematically cheated out of their wages in many ways and much corruption existed. The men were often

compelled to lose their pay by being transferred to another vessel, the purser of the first ship drawing the pay on a forged ticket. Until the 19th century men were only paid at the end of the vessel's commission and this was often abnormally long. In 1811 the *Centurion* had been 11 years in the West Indies; the *Rattlesnake,* 14, and had come home with but one man of her old crew; the *Fox* had, at this time, been out for 15, and the *Albatross* for 12, years. The crews of these vessels had practically no money during these periods, and upon arrival home were given pay tickets which, by an iniquitous practice of selling and discounting, usually netted them comparatively small amounts. The mutiny at Spithead in 1797 was responsible for the correction of many of the irregularities of the service; among them the question of payment of wages was put on a better basis, which has since, of course, had all unsatisfactory features corrected. It was not until the middle of the last century that men were paid regularly on shipboard. At present weekly payments are made.

Marines were first organized October 28, 1664; one regiment, previously known as "The Duke of York and Albany's maritime regiment of foot" was raised. It was disbanded in February, 1689. In 1690 two regiments were again raised, only to be disbanded in 1699. At the beginning of the 18th century, under Queen Anne, marines were finally permanently established.

Uniform.—Regarding officers, until the year 1739 "every man dressed as seemed good in his eyes." Throughout the Middle Ages soldiers customarily wore some distinctive mark or badge even at such times as they served afloat, but this could hardly be called a uniform. Before Anson's time officers frequently purchased soldier's coats at army stations and trimmed them in a manner to suit their individual taste, red faced with black, gray faced with red, being often seen. In the *Kent* 70, in 1745, all the officers wore gray trimmed with silver and scarlet. "Such foppery, however, at that time, was not infrequently combined with checkered shirts and petticoat trousers."

In 1747 Lord Anson, then of the Admiralty, in response to a rather general request that a uniform be established, "agreeable to the practice of other nations," appointed a Board which finally recommended that the color should be blue with red trimmings. The King, however, disapproved this and chose blue and white, by reason, it is said, of the favorable impression made upon him

by the Dutchess of Bedford, whom he saw at this time riding through the park in a habit of those colors. This first adoption of a uniform for line ranks was announced to the naval service by an order dated April 13, 1748. Many small changes in cut, color and the wearing of lace and ornaments followed. In 1774 white trousers appeared instead of blue, and the higher ranks were distinguished by various groupings of buttons.

In 1787 the low collar, with which we are familiar in our Revolutionary portraits, became the standing stock, such as was worn during the war of 1812. The early hat was a low-crowned three-cornered affair; later this was raised in height, as was the French custom; by 1790 it had become cocked on but two sides, was made very high and was worn "athwartships." In 1825 the present shape was adopted and ordered to be worn "fore and aft." Epaulettes were made uniform in 1795, although in France and Spain they had been worn for many years. They were at first simply gold tassels. Only the higher officers wore two; a more or less elaborate arrangement existed regulating the shoulder and the style of epaulette in the case of junior officers. In 1812 they were made uniform for lieutenants and lower officers. The early epaulettes were held in place by straps of considerable size, in which we see the origin of our shoulder straps. It was not until 1805 that a distinctive uniform was adopted for medical officers, and in 1807 followed that for pursers and masters. In 1823 long trousers were allowed, and a few years later knee breeches were discarded. In 1843 officers of the executive branch wore coats double-breasted, and officers of the civilian branch, single-breasted. The regulation frock coat was adopted in 1847, a ship jacket followed, and in 1879 the present blouse was adopted.

British seamen possessed what might be called a uniform long before their officers did. From early times it had been customary for the Admiralty to supply clothing and to retail it to the men, much as "slop" clothing is now sold to merchant sailors. In 1660 we note that red caps, yarn stockings, blue or white shirts, flat-heeled shoes and canvas suits were carried in stock. In 1706 gray jackets, striped waistcoats, red breeches and red caps became the ordinary dress and remained so until about 1750. The dress of a seaman during the latter part of the 18th century was: "a little low cocked hat, a pea jacket, a pair of petticoat trousers, not unlike a Scotch kilt, tight stockings and shoes with buckles."

The hat was usually made of canvas and tarred, which gave the wearer the name of "tarpaulin." About 1800 the waistcoats, shirts and trousers were commonly of red, the jackets of blue baize or yellow nankeen with a canvass petticoat falling to the knee. This combination was seen until about 1820. From that time until 1857 the usual dress was a blue jacket, white trousers, and a tarpaulin hat. Checkered or striped shirts were often worn. In 1857 the men's uniform, quite as at present, was prescribed. The blue jacket and the tarpaulin hat were finally abolished in 1891. A cap ribbon, showing the name of the vessel to which the wearer belonged, was worn in some ships before 1780. The black neckerchief first appeared, as a badge of mourning, after the death of Nelson. The three lines of white tape on the broad collar are said to have been first used to commemorate the three victories of Nelson: Copenhagen, the Nile and Trafalgar. Commanding officers before 1850 were allowed a good deal of latitude in prescribing uniforms for their ships. In 1840 the captain of the *Vernon* had his starboard watch wear blue jerseys, and the port, red. The *Blazer's* crew in 1845 wore blue and white striped jerseys. The captain of the *Harlequin* dressed his gig's crew as harlequins. The *Caledonia's* wore Scotch caps, and one captain, who was serving on the Greek coast, had his crew dress in petticoat trousers. Pigtails, a French custom, never were very common in the British service. The practice originated after the fall of Napoleon and ceased about 1826.

Laws and Punishments.—The early English sea laws were based on the so-called "Laws of Oleron," a code founded in the republic of Rhodes, on ancient sea customs, and acknowledged by all the European sea coast south of the Baltic. It was probably introduced into England by Richard I. Among many other punishments this severe code prescribed: "whoever shall commit murder on board ship shall be tied to the corpse and thrown into the sea." If committed on land, he was tied to the body and buried with it. For stabbing or cutting another "so that blood shall flow," he was to lose a hand. A man convicted of theft was punished by having boiling pitch poured over his head and shoulders and "a shower of feathers shaken over to mark him." All seamen were forbidden to undress themselves, unless in port for "wintering," probably so ordered that they should always be ready for duty. The penalty for disobedience was to be hoisted

to the yard arm and ducked by "letting go" three times. For the first offence of drunkenness cold water was poured down the offender's sleeves. A lookout who had slept four times on watch was lashed to the bowsprit with a knife in one hand so that he might either die of starvation or cut himself down and drown. Swearing was punished by three knocks on the forehead by the boatswain's whistle; smoking anywhere but on the upper deck, "and that sparingly," by the bilboes. At a later date a thief was dragged ashore lashed to a grating, and then turned adrift.

Flogging, tongue-scraping, gagging, keel-hauling and tying up with weights about the neck were common as early as the 16th century. In 1645 the ship court martial was instituted and written records submitted. It may be interesting to note the following historical entry from a ship's log made in 1675: "a scolding woman was well washt to-day."

Naval law received its first codification under the Commonwealth. The first regular articles of war were issued in 1652 and were a modification of the Earl of Warwick's fleet instructions. Out of 39 articles 13 prescribed death and 12 more allowed the sentence to be imposed. In 1749 they were amended and many paragraphs were then first written which are almost word for word the same as those in force to-day in our own service as well as that of the British. In 1757 Admiral Bing was executed in compliance with the provisions of the following article, the wording of which is quite familiar: "Every person in the fleet who through cowardice, negligence or disaffection shall in time of action withdraw or keep back, or not come into fight, or engagement, or shall not do his utmost to take or destroy every ship it shall be his duty to engage; and to assist all and every of his Majestie's ships or of his allies, which it shall be his duty to assist and relieve; every person so offending and being convicted thereof by sentence of Court Martial shall suffer death." In 1788 the following article appeared which bears a strong resemblance to one of our own: "Every officer or other person in the fleet who shall knowingly make or sign a false muster or muster book, and upon proof of any such offence being made before a court martial, shall be cashiered and rendered incapable of further employment."

The first printed instructions relating to the conduct of the fleet, published about 1650, contains the following article: "When

fish is to be had, the captain is to employ some of the company in fishing, and the fish which shall be caught shall be distributed daily to such persons as are sick or upon recovery, and if there be any surplus the same shall be distributed by turns amongst the messes of the officers and seamen, without favor or partiality, and gratis, without any deduction on that account." Contrast this with the following, paragraph 16, "Acts for the government of the Navy of the United States," adopted March 2, 1799: "All ships furnished with fishing tackle, being in such places where fishing is to be had, the captain is to employ some of the company in fishing. The fish to be daily distributed to such persons as are sick, or upon recovery, provided the surgeon recommends it, and the surplus, by turns, amongst the messes of the officers and seamen, gratis, without any deduction of their allowance of provisions on that account."

As late as 1854 there were no cells in British naval vessels. Flogging, an ancient form of punishment, was very common at that time. In many ships all hands were piped to witness punishment every few days, while in others, usually better ships, but few, in many instances only four or five, would be so punished during an entire cruise. Flogging was finally abolished in 1879.

Victualling.—The chief article of naval diet was, for many years, dried (stock) fish. During the reign of Queen Elizabeth all food for the navy was supplied by contractors, a method which was soon after abandoned and a victualling department established under the Admiralty. At that time the seaman's daily allowance was: one gallon of beer, 1½ pounds of bread or biscuit, 2 pounds of fresh or salt meat, with ½ pound of butter and ½ pound of cheese six times per month. The component parts of the men's ration constantly changed but, on paper at least, it was always fairly generous. During the time of the Commonwealth the quality of food improved, a reflection of the times, for almost all branches of the service improved markedly under Cromwell. It was followed, however, by a long period of abuse and mismanagement, during which the men fared badly and their food became wretched. Up to the early part of the 17th century beer, one gallon a day per man, was the only article of beverage taken to sea by either men-of-war or merchant vessels, no water being carried except a small amount for cooking purposes. The poor quality of beer issued was a frequent cause for complaint.

Raleigh says that old fish and oil casks were used for this purpose. Finally brew houses were established at the principal naval stations. The use of beer afloat was not done away with until about 1835. Rum was first issued, one-half pint daily, early in the 18th century, after experiments with French wines and brandy. In 1740 Admiral Vernon issued orders that the ration of rum should be served out diluted with one-half its volume of water, which custom has continued ever since.

Vernon was called by his men "Old Grog," from the fact that he was accustomed to wear an old grogram coat in bad weather; the name of the mixture is in this way associated with him. In 1824 the spirit ration was reduced to one-fourth pint on account of much drunkenness, and tea and cocoa added. This allowed the stopping of the two "banyan days" each week, when no meat was issued. At the same time "burgoo," an unpalatable mixture of oatmeal, molasses and water, served often for breakfast, was discontinued. In 1850 the spirit ration was again reduced one-half and a small money gratuity allowed. In 1881 the issue to commanding officers was cancelled, and also to boys under 20.

Tobacco was first supplied in 1798. In 1839 it was ordered sold to enlisted men for the standard price of one shilling a pound; this price never varies and is that paid by the men to-day. The term "salt junk" was used two hundred years ago; "junk" being the bulrush of which ropes were formerly made, and hence meat which was tough and ropy. Meat was "preserved" as early as 1812, but at first its use was confined as "medical comforts" and issued in the sick bay.

Hygiene and Medical Affairs.—From a modern standpoint hygiene and sanitation, in past times in the British navy, were systematically neglected, resulting in a fearful mortality and many embarrassments for the government. Very high death rates prevailed on the average vessel until comparatively recent times. Sir Walter Raleigh stated that in twenty years 10,000 men died of scorbutic affections. Immediately after the defeat of the Spanish Armada in 1588, the Lord High Admiral (Howard) wrote, "sickness and mortality began wonderfullie to growe amongste us . . . . the *Elizabeth* . . . . hath had a great infectione in her from the beginning soe out of 500 men which she carried out, before she had been in Plymouth three weeks there were ded of them 200 and above, soe I was driven to set the rest ashore and

to take out the ballast and to make fires in her of swet broom, three or four daies together . . . . and got new men, very tall and hable as ever I saw, and put them into her, and now, the infectione is broken out in greater extremity than ever before and they die and sicken faster than ever." At a somewhat later date Monson states that "where we had one man dyed by shott in the navy, we had ten dyed by bad provisions." In 1656 the *Sterling Castle* 64, less than three months out on a new cruise, had 160 men sick with dysentery. Admiral Hosier, cruising in the West Indies about 1700, with seven ships, buried his ship's companies three times over. A chaplain writing in the year 1675 gives the following data:

Feb. 7. Buried two out of our shipp, "little better than starved to death."

Mar. 22. I buried Francis Forrest, as 'tis said eaten to death with lyce.

May 1. I buried Henry Johnson out of the gunn-roome port.

May 12. I buried Mr. Richard Cooling in a coffin.

May 30. We sent to shoare 32 sick men, pittiful creatures.

These entries are simply samples of the chaplain's diary, which states that between the first and the last date 22 men died. This makes the mortality for this ship 165 per 1000 per annum, and yet this was not an exceptionally unhealthy vessel. It is probable also that not all the deaths on board were recorded.

From 1776 to 1780, 155,000 men were raised; of this number 1250 were killed in action, 18,500 died of sickness and 42,000 ran. The combined French and Spanish fleet which Nelson chased across the Atlantic just prior to the battle of Trafalgar, landed 1000 sick in the West Indies and also buried that number of men during its stay there of 40 days. In 1779 Nelson's ship lost 140 men of a crew of 200, chiefly by dysentery. While some commanders managed to keep their ships healthy, they were the exceptions; the vast majority suffered fearfully. Drake was known to have been a very careful man in these matters. It is on record that he habitually bled his entire ship's company before crossing the line and going into the tropics. Captain Cook, during a voyage of over two years, lost but four men; this is an enviable record and probably the most creditable to be found.

The reason for this terrible mortality is to be found chiefly in the very unsanitary condition of the old wooden ships. The holds contained ballast in the form of gravel, sand and even earth,

this was removed at very infrequent intervals and became, naturally, a chief source of infection. The French actually buried the bodies of many of their dead in this ballast, and at least one authentic instance of this practice is known to have occurred in the British service. Leaky ships, from the constant removal of bilge water, were traditionally known as the more healthy ships. Water was a very common source of disease. It was stored in casks and rapidly became foul, if not so when hoisted in. Iron tanks were not known until after 1820. The wooden decks of these old vessels, especially the lower ones, were almost constantly wet and soggy, due to daily flooding and scrubbing, in an otherwise laudable effort to excel in cleanliness. The poor and often insufficient food caused, as we have seen, much trouble. The cooking facilities were wretched for many years. But one cooked meal was prepared each day up to 1600. It is probable that the heavy nitrogenous character of the old ration resulted in a form of ptomaine poisoning to which the great number of cases of scurvy was due. The infectious nature of certain diseases was for a long time unappreciated. In November, 1625, Wimbleton, the commander of an ill-fated expedition to Cadiz, on an outbreak of plague (?), actually transferred the sick, designating a certain number to each ship in the fleet, in order that no one ship should become shorthanded.

As early as 1655 a patent had been granted for a method of salt water distillation, but it was not until 1772 that a still was ordered for all British ships. These supplied but a small proportion of the fresh water consumed at sea. Some commanding officers had learned that beneficial results followed the use of boiled water, and in 1756 the captain of the *Sterling Castle* is known to have kept his sick list down in this manner. Lemon juice as an antiscorbutic was first carried to sea by Captain Lancaster, in an expedition sailing from England for the East Indies in January, 1600. Three ounces were given daily to each man. When Cape Town was reached Captain Lancaster's ship, the *Dragon,* alone was free from scurvy, and his ship's crew hoisted out the boats of the entire squadron and landed the sick, 105 of whom died there.

Hospital ships were used at various times for the relief of the wounded after battle. In 1608 the *Good Will* was so employed in the Mediterranean, but the commander-in-chief, need-

ing another vessel, the sick were hastily landed in Spain and the vessel converted into a fighting ship. In 1727 the British owned one of these vessels, its size being equal to that of a 40-gun ship; in 1760 there were three of the size of a 50-gun ship. In 1793 the *Dolphin* was used as a hospital ship in Hood's fleet off Toulon, as in 1794 the *Pharon* was used at the battle of "the first of June." In 1854 a hospital ship was attached to the British contingent at the Crimea. In 1653 ships were allowed "medical comforts" to the value of 5 pounds per 100 men per six months, men invalided ashore received full pay until recovery, and civil hospitals were ordered to accommodate those sick who should be sent to them. The first hospital for disabled seamen was given by Queen Mary, who devoted for the purpose the unfinished palace at Greenwich and a considerable sum of money. For its maintenance 6 pence per month was deducted from the pay of all seamen, naval and merchant. This hospital is in existence to-day. The "Chatham chest" was an institution founded by Drake and Hawkins in 1590 for the purpose of giving disabled seamen pensions. It was maintained for years by the contribution of a small portion of the men's wages and by a certain amount of prize money. After several periods of mismanagement it was finally done away with in 1803, government pensions having taken its place.

Customs.—One of the most ancient British naval customs was the salute demanded by the King's ships of all vessels met in "His Majestie's seas," which extended from Cape Finisterre through the "narroe seas." All other ships were expected to "take in" their flags and to strike their topsails. The wars with the Dutch were, in great part, caused by the enforcing of this demand. The more recent custom, which has not entirely died out, of lowering a sail, letting fly sheets or backing a top-sail as a mark of respect, is a direct decendant of this 17th century demand. "Salutes with guns are as old as the guns themselves," and great expenditures were borne by the State on this account throughout the 17th and 18th centuries. Salutes of courtesy were given on all occasions: often as the commanding officer left his ship, when his wife came on board, when ships met at sea and on their return to port. Dressing ships with flags and manning the rail and yards was practiced during the reign of Elizabeth.

The order of precedence laid down for officers boarding or leav-

ing a vessel of war, or a boat, was in force over 150 years ago. The starboard side of the quarter deck and the starboard gangway have been the "dress" side of the ship for fully as long. Shortly after the mutiny at the Nore, however, the port side was so regarded, the starboard having been considered violated by the mutineers. During the time of Lord St. Vincent all officers were required to be present at colors in the morning and in the evening. At that time all officers on deck acknowledged the salute of one "saluting the quarterdeck." The present answers to hails after dark in use in our navy are almost identical with those used by the British, except they do not use the words "passing" and "halloo." This custom has changed but slightly during the past one hundred years.

The British regulations of 1808 prescribe the parading of the marine guard for passing ships. The custom of having daily prayers comes from the days of Cromwell and the Commonwealth, at which time Blake instituted the practice of singing hymns or psalms at the changing or "setting" of the watch, at eight p. m. The use of the broad arrow as a mark for government property dates from the reign of Elizabeth, and cordage and canvas have been marked by a colored thread, a "thief strand," woven into the material, for many years.

The custom of drinking to "sweethearts and wives" was in vogue as early as 1650, and captain's tables were known at that time to have afforded such delicacies as "ribbs" of beef, plum pudding, "roosted hens," "raysings," almonds, blue figs, "minct" pies, woodcock pies, English pippins, and "punch galore." Dinner for captains was, at the beginning of the last century, customarily served between 3 and 4 p. m. Supper in the gun-room and ward-room was served at 6.30; after that the seniors from the ward-room often came into the junior officer's quarters to play cards, sending the youngsters out, the signal for which was a fork stuck into a beam overhead. "Orgies were of almost nightly occurrence." As early as 1600 it was customary to allow the trumpeters, with all who would tailing on, to play at each officer's door and all over the ship, much as we now sometimes see done at midnight of New Year's eve.

Quarters.—Probably up to 1600 all officers ate in their own rooms or, in default of them, in such place as they wished. From that time on, small messes were formed by certain groups of

officers, but it was not until 1750 that we hear of a "ward-room"; at that time it was described as "a place where the lieutenants mess and sleep." In 1761 marine officers were ordered to mess with the captain. At certain times also "the lieutenant" and the chaplain messed in the cabin. Before the beginning of the 17th century we find no mention of rooms for any except the captain. After that date canvas partitions were often rigged for this purpose and, at times, wooden bulkheads were used. The rooms made in the latter way were spoken of as "sluttish dens that breed sickness, cover stealths, and in fight are dangerous to the men with their splinters." The term "stateroom" was used in 1675. Until recently guns were carried along the decks throughout the officers quarters, and it was customary, as long as wooden ships remained, to remove the more or less temporary bulkheads in and around officer's quarters and thus open the deck before action. These bulkheads were sometimes simply hinged and triced up; at other times a temporary canvas screen was rigged. During the Nelson period this was the common practice, the ships being almost constantly cleared for action.

Ordnance.—Powder-burning guns first appeared in England in 1338. They were small breech-loading affairs throwing usually a stone projectile, which material was so used until 1625. By 1515 guns were roughly calibrated and threw shot weighing 74 (with 30 pounds of powder), 60, 42, 32, 26, 18, 11, 6, 2, and .5 pounds. Comparatively little change in ordnance took place for many years. Even at the outbreak of war with Russia in 1854 the 68-pounder smooth bore, using 16 pounds of powder, was the heaviest gun afloat. During the time of the Stuarts, fewer sizes were employed, the 58-, 32-, and 24-pounders, with the 5-pound "sacker" and 2½-pound "falconet," were the standard patterns. In 1743 the following guns were in use: 42-, 32-, 24-, 18-, 12-, 9-, 6-, 4-, 3-, and .5-pounders. The 42-pounder was shortly after considered too heavy, and the 32, the heaviest gun used during the Napoleonic wars, with the 18- and 12-pounder, constituted the ordinary armament for large vessels. After 1806, 24's largely took the place of the 32's. About 1830 a 48- and a 68-pounder were introduced. Carronades came into use during the year 1779; they were issued as 68-, 24-, 18-, and 12-pounders, and took their name from the town of Carron in Scotland, where they were first cast.

Up to 1856 almost all guns were of the muzzle-loading, smooth-bore pattern. Shrapnel was named for Lieutenant-General Henry Shrapnel, who invented it in 1792. It was adopted in 1803. Shell guns were the invention of Col. Paixhans, a French officer, in 1827. At the end of the Napoleonic wars the flint lock was the regulation small arm. In the late 30's a percussion-cap musket called the "Brown Bess" appeared. A primitive rifle was adopted in 1842. The caliber of small arms was, up to about 1860, .70 to .79.

Painting.—An interesting fact concerning "war color" paint is to be found in the statement that the early British vessels, about A. D. 80, in order to escape notice, were said to have been painted a light blue color. Up to and including the time of the Commonwealth, ship's hulls were painted black, with much gilt and colored ornamentation at the bow and stern; this reached its highest pitch about 1680. From shortly after this time until 1801 blue upper works, canary yellow sides and a wide black strake at the water line was the customary method of painting. The inside of the upper works, and sometimes the gun decks, were painted a blood-red color. Lord Nelson required his vessels to paint the exterior black, with a yellow stripe along each tier of gun-ports. This was known as the "Nelson mode" and became practically universal for all men-of-war, was extensively copied by merchant vessels and is even to be seen to-day. The inner sides of the port-holes remained red for many years. During and after the 30's the yellow stripe was usually changed to white. The interior of ships during Nelson's time, as before, was customarily painted green, buff or light brown; this later became white, whitewash being used forward and paint aft. Mast hoops were ordinarily black, but Nelson at Trafalgar ordered his ships to whitewash theirs that they might distinguish each other in the smoke of battle.

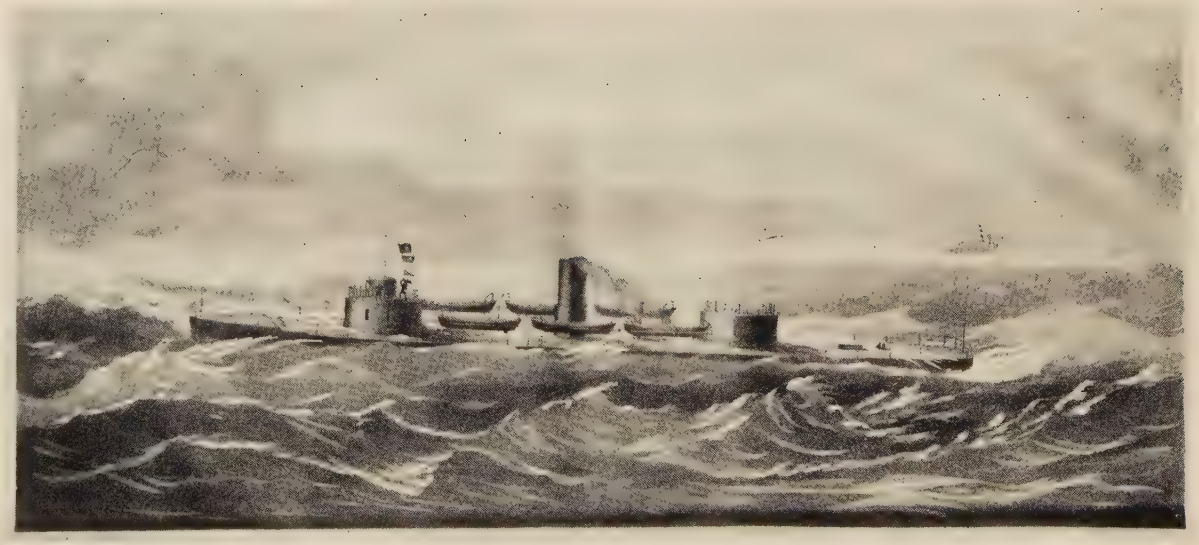
Women on Shipboard.—Lord Exmouth, after the bombardment of Algiers in July, 1816, stated in his report that "even British women served at the same guns as their husbands, and, during a contest of many hours, never shrank from danger but animated all around them." In probably no considerable action during the one hundred years previous to this date was not this also true.

Officer's wives were allowed to be carried in men-of-war until the Admiralty issued an order against it in 1830. It was evaded.

however, especially by commanding officers, in many ways. Often the family of one captain would take passage as the guests of another captain in the same fleet, instances of which were seen as late as 1869. Mrs. Nelson went to England from the West Indies with her husband in the *Boreas* in 1787. Codrington had his family on board the flag-ship *Asia* until just before the battle of Navarino, in 1827.

ESPECIAL REFERENCES.

"The Royal Navy, a History." Wm. Laird Clowes.
"The British Fleet." Commander Robinson, R. N.
"The Administration of the Royal Navy, 1509-1660." M. Oppenheim.
"With the Flag at Sea." Walter Wood.



U. S. IRON CLAD BATTERY ONONDAGA
WITH 2 ERICSSON TURRETS.

FROM A LITHOGRAPH MADE FOR THE NAVY DEPARTMENT, AND PRESENTED BY THE ASSISTANT SECRETARY OF THE NAVY, HON. G. V. FOX, TO WILLIAM BOERUM WETMORE IN 1863.

DISCUSSION.

The First Dreadnought.

To the Editor of the U. S. Naval Institute Proceedings:

In the Proceedings for December, 1909, there was published a letter from me claiming that the frigate *Roanoke* was altered into a dreadnought in 1863, and that she was the first of the type. Mr. Percival A. Hislam has since replied, claiming that Great Britain had the honor, as the old frigate *Royal Sovereign* was altered like the *Roanoke,* but in 1862-63, thus antedating the *Roanoke,* though she carried one gun less, namely, five instead of six. On one of my walls hanging alongside of the lithograph of the *Roanoke* is another, of an ironclad called the *Onondaga,* made for the Navy Department and presented to me in 1863 by the late Hon. G. V. Fox, the Assistant Secretary (a photograph of which is here reproduced).

Though antedating the *Roanoke,* I did not originally make a claim for her, preferring to take the heavier ship, but as Mr. Hislam has put forward the *Royal Sovereign,* I now enter the *Onondaga,* to try to go him one better. As dates in this argument are important, I wrote to Lord Brassey, one of the best English authorities on naval matters, to get all the particulars about the *Royal Sovereign,* and I quote his reply:

"The exact date—day and month—of the conversion of the *Royal Sovereign* is hard to determine. The time occupied in the conversion was long and the cost great, and took place between 1862-64. The vessel made her official trial of speed and power of circling, with full and reduced steam pressure, in Stokes Bay in June, 1864. The speed after conversion at the measured mile was eleven knots. In July she began a series of experimental firing trials off the Isle of Wight, which were continued throughout the autumn off Portland harbor. She does not appear to have ever been a fully commissioned seagoing ship afterward, being principally used as a tender to the *Excellent.* Her only officers were a staff commander and chief engineer 'borne in *Excellent.*' No sails were carried on her three pole masts after conversion. She was armored all over. Her sides were composed of three feet of solid timber, strengthened internally by diagonal iron bands, and clothed externally to the usual distance below the water-line with 5½-inch rolled armor plates."

It will thus be seen that both the *Royal Sovereign* and the *Roanoke* were frigates altered into dreadnoughts, the former, however, carrying one gun less.

Now the *Onondaga* was not an altered vessel. She was authorized and absolutely laid down as a dreadnought. The Secretary of the Navy sent a communication to the House of Representatives dated December 1, 1861, asking for "the immediate construction of twenty-one ironclad steamers."

The House promptly responded to this recommendation, and passed a bill "authorizing and empowering the Secretary of the Navy to cause to be constructed, by contract or otherwise, as he shall deem best for the public interest, not exceeding twenty-one, etc., ironclad steam vessels of war." Among these was the high-freeboard *Onondaga,* the only one, as far as I know, of this type. The rest were the low-freeboard monitors, the *Manhattan, Tippecanoe, Dictator, Weehawken,* and vessels of other types. It is, therefore, fair to assume from the wording that this bill was passed for the *Onondaga* the first week and not later than the second in December, 1861.

Now the *Royal Sovereign* and *Roanoke* were altered vessels, but here is a bona fide ironclad dreadnought authorized as such at the start, the year previous to the altering of the *Royal Sovereign,* although carrying one gun less.

The *Onondaga* was built at the yard of T. F. Rowland of the Continental Iron Works at Greenpoint, Long Island; George W. Quintard, proprietor of the Morgan Iron Works, New York, being the contractor for the hull and machinery. The *Onondaga* was of 1250 tons; length, 228 feet; beam, 50 feet; had four propeller engines, the diameters of whose cylinders were 30 inches, with a length of stroke of 18 inches. Her hull was armored for its whole length. In a letter from Admiral W. L. Capps, Chief Constructor United States Navy, to whom I am indebted for some of the information herein contained, he writes: "In accordance with an act of Congress dated March 2, 1867, the *Onondaga* was returned to George W. Quintard, on payment by him to the government of $759,673, being the amount received by him for building said vessel. After the transfer of this vessel to Mr. Quintard, it was sold by him to the French government, where (its name having been changed) it served for years in the French Navy."

It will thus be seen that the *Onondaga* antedates the altered *Royal Sovereign* and *Roanoke,* and was absolutely laid down at the start as an armored vessel having, though smaller, the properties of the dreadnought. —WILLIAM BOERUM WETMORE.

FROM THE NAVAL AND MILITARY RECORD.

THE GERMAN BATTLESHIP RHEINLAND

PROFESSIONAL NOTES.

Prepared by Professor PHILIP R. ALGER, U. S. Navy.

SHIPS OF WAR, BUDGETS AND PERSONNEL.

ARGENTINE REPUBLIC.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Rivadavia	28,000	Fore River Shipbl'dg Co.	Building.
Moreno	28,000	New York "	"

For a comparison of these ships with the latest U. S. battleships, see United States.

AUSTRIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Radetsky	14,500	Trieste.	Launched July 3, 1909.
Zrinyi	14,500	"	" April 12, 1910.
Erzherzog Franz Ferdinand.	14,500	"	Under trial.
Tegetthoff	20,000	"	Building.
Kaiser Franz Joseph	20,000	"	"

Two of the new Austrian battleships will be named *Tegetthoff* and *Kaiser Franz Joseph.* There is still some uncertainty as to whether these ships are actually being built or not. There is no doubt whatever that material has been collected for them, but there are some fairly reliable reports to the effect that work has not proceeded further yet. On the other hand, equally reliable reports speak of them as fairly well advanced.

The armament will consist of twelve 12-inch and sixteen or twenty 4-inch. It is by no means certain how the big guns will be arranged. According to the *Rivista Marittima* there will be four triple turrets arranged as in the *South Carolina* and *Michigan.* According to another report there will be triple turrets arranged *en echelon* like our *Invincible* class, but with higher command to the two middle turrets. This, incidentally, is identical with the arrangements attributed in some quarters to the new Russian ships of the *Gangoot* class. Yet a third version of the new Austrian battleships is that they will have six turrets in the center line arranged as in the latest American battleships, and this, perhaps, may be the more likely arrangement of the three. Triple turrets have a habit of not materializing.—*The Engineer.*

According to *Le Yacht,* the two ships referred to above are being built at the Stabilimento Tecnico of Trieste, and two other similar ships are to be built at Pola and by the Société Danubius at Fiume, respectively.

BRAZIL.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Rio de Janeiro	19,250	Elswick.	Building.
São Paulo.	19,250	Vickers.	Under trial.
Rio de Janeiro	32,000	Elswick.	Ordered.
Scouts.			
Bahia	3,500	Elswick.	Under trial.

The scout *Rio Grande do Sul* has completed her trials and been formally handed over to the Brazilian Government. The great floating dry dock, built by Vickers, Sons & Maxim for Brazil, has also been completed and is on its way to Rio de Janeiro.

Respecting the new battleship *Rio de Janeiro,* which Sir W. G. Armstrong, Whitworth & Co. have on hand for the Brazilian Government, several inaccurate statements have lately been published in the north-country daily papers, and reproduced broadcast. It seems desirable, therefore, to place on record the actual facts, in order to avoid further confusion. The new battleship will be 655 feet in length overall by 92 feet beam, and will have a draft of 26 feet, and a displacement of 32,000 tons. Her armament will consist of twelve 14-inch guns, fourteen 6-inch guns, fourteen 4-inch guns, three 6-pounder landing guns, six machine automatic guns and three 18-inch torpedo-tubes under water. She will not only be very much larger than the *Minas Geraes* and *São Paulo,* already built for Brazil at Elswick and Barrow, respectively, but the *Rio de Janeiro* will also be bigger by a good deal than any battleship in, or at present in course of construction for, our own navy. The machinery will be of the improved turbine type, to be manufactured by Vickers, Sons & Maxim, Limited, and will drive four screws and give a speed of 22½ knots. A definite commencement has recently been made at Elswick with the laying down of this new battleship, and a completion will be reached within two years from date. The approximate cost is understood to be no less than £2,900,000.—*The Engineer.*

TRIALS OF THE "SÃO PAULO."—Under the supervision of the Brazilian Naval Commission, the battleship *São Paulo* has just carried out her trials with the most satisfactory results.

The *São Paulo* and *Minas Geraes* are the product of the combined experience of Armstrong, Whitworth & Co., and Vickers, Sons and Maxim.

The *Minas Geraes* was built at Elswick and engined by the Vickers Co., who built as well as engined the *São Paulo.* The ships are alike, the design having been prepared by Mr. J. R. Perrett, and the two firms have succeeded in meeting the strategical and tactical needs with a large measure of success, as was clearly established during the trials just terminated. Notwithstanding that the draft was wisely limited to 25 feet, a high fighting efficiency has been achieved.

Firstly, the ships have twelve 12-inch guns so disposed that eight can be fired ahead, eight astern, or ten on either beam. In addition, there are twenty-two 4.7-inch guns and eight 3-pounders.

Secondly, the broadside is protected right fore and aft; the thickness is 9 inches in the center part for the full depth of 22 feet 4 inches, including 5 feet below the load water line. This thickness is reduced to 6-inches forward and aft, and ultimately to 4 inches at the bow and stern; 9-inch athwartship bulkheads are located forward and aft at the ends of the 9-inch armor as protection against raking fire, while at the bow there is a 3-inch bulkhead, and at the stern a 4-inch bulkhead. The heavy guns are mounted in barbettes with 12-inch and 8-inch armor, and the mechanism is covered with hoods. Fourteen of the 4.7-inch guns are on the main deck, protected by the 9-inch armor, while the eight remaining guns on the upper works have shields.

In the third place the full speed attained—21.623 knots—practically equals the average rate attained by the British *Dreadnought* battleships, although special care had to be exercised in the design of the machinery in order that the steaming conditions might be easily met when using such coal as is readily available in South America, since this may not always be of the high calorific value of the better anthracites, and in order also to meet any deficiency in the skill of the stokers. Thus, for instance, the proportion of heating surface to grate area is about 36 to 1, as compared with from 30 to 33 in the British service. A a consequence, the boilers

of the Brazilian ships are larger and heavier for a given power, but there is gain in greater reliability under the conditions of South American service. Reciprocating engines have been adopted and have proved of high efficiency, the radius of action, according to the results of the *São Paulo* trials, being 29 per cent greater than that guaranteed—or 12,913 nautical miles instead of 10,000 at 10 knots. The full speed on trial—21.623 knots—was realized with 28,645 indicated horse-power, while the guarantee was for 21 knots. On a trial of about four hours' duration, during which six runs were made over the measured mile, a speed of 21¼ knots was attained with 25,517 indicated horse-power. On an eight hours' trial a speed of 20.99 knots was got with 22,355 indicated horse-power, the guarantee being 20 knots.

We may, in a brief table, recapitulate the main features of the *São Paulo* and *Minas Geraes:*

Length over all	543 feet.
Length between perpendiculars	500 feet.
Breadth, moulded	83 feet.
Depth, moulded	42 feet 3 inches.
Draft	25 feet.
Displacement at 25 feet draft	19,280 tons.
Speed at full power	21,623 knots.
Indicated horse-power	28,645 I. H. P.
Normal coal capacity on 25 feet draft	800 tons.
Total bunker capacity	2360 tons.
Radius of action determined on 48-hours' trial at 10.6 knots	12,913 sea miles.

Armament—

Twelve 12-inch 45-caliber guns.
Twenty-two 4.7-inch 50-caliber guns.
Eight 3-pounder guns.

Armor—

Broadside	9-inch, 6-inch and 4-inch cemented steel.
Protective deck	2-inch.
Main bulkheads	9-inch.
Gun-barbettes	12-inch.
Forward and after athwartship bulkheads	3-inch and 4-inch.
Machinery—Engines, triple-expansion, four-cylinder type.	
Diameters of cylinders: high-pressure, 39 inches; intermediate, 63 inches; and two low-pressure, 73 inches. Stroke, 3 feet 6 inches.	
Total cooling surface of condensers	24,000 square feet.
Boilers, eighteen of Babcock and Wilcox type.	
Heating surface	58,370 square feet.
Grate area	1,686 square feet.

The gunnery trials took place off the *Clyde.* The same program was gone through in this ship as in the *Minas Geraes,* with the addition that a complete broadside of eleven 4.7-inch guns was fired simultaneously with a broadside of ten 12-inch guns, so that a record in the way of broadsides was again established. Admiral Bacellar himself pressed the firing key which fired this tremendous broadside; every one of the 21 guns responded. To attain this result is in itself a feat of some difficulty. Excellent practice was also made during the trial at a target. Another important feature was the firing of two 12-inch guns in an upper turret, laid horizontally and fore and aft directly over a lower turret. Several Brazilian officers and two British officers remained in the lower turret during this test, and were able to state that they suffered no inconvenience.—*Engineering.*

In view of the expansion of the Brazilian Navy the annual report of Admiral Alexandrino de Alencar, Minister of Marine, which appears in the *Revista Maritima Brazileira,* is a document of considerable importance. The program of 1906, modifying that of 1904, provided for the battleships *Minas Geraes* and *S. Paulo,* the scouts *Bahia* and *Rio Grande do Sul,* and 10 destroyers, and involved an initial change of £5,206,084, leaving a sum of £1,810,810 to be paid. The gross displacement of ships of the Brazilian Navy is being increased from 14,000 tons to 93,594 tons, but this is represented by the Minister as not being enough, because the new program of Argentina is to give that state a navy displacing in all 101,000 tons, while Chile will have 27,000 tons. The program includes also the battleship *Rio de Janeiro,* and a movement is on foot to procure funds for the building of a fourth ship to complete a fleet unit. This has been initiated by the Brazilian Navy League, which has allotted the sum to be raised by each province and municipality. Local feeling is being appealed to, and the ship is prepared to be named *Riachuelo.* The names of the two principal subscribers will be engraved on the guns, and a complete roll of subscribers will be preserved on board in a coffer to be presented by the Navy League.

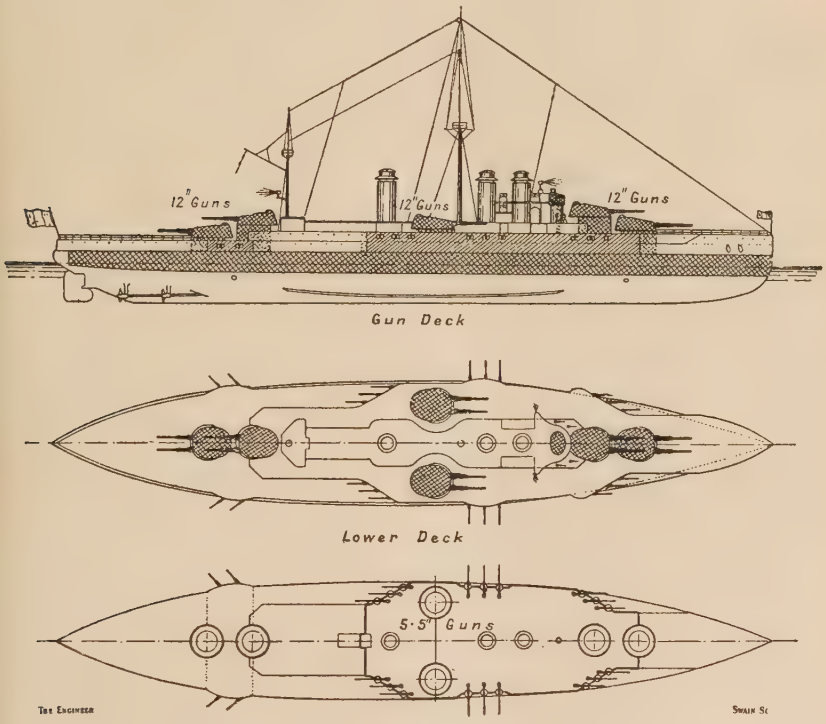
FRANCE.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Danton	18,350	Brest.	Launched July 4, 1909.
Mirabeau	18,350	Lorient.	" Oct. 28, 1909.
Voltaire	18,350	Bordeaux.	Under trial.
Diderot	18,350	St. Nazaire.	Launched Apr. 19, 1909.
Condorcet	18,350	"	" Apr. 20, 1909.
Vergniaud	18,350	La Seyne.	" Apr. 12, 1910.
Courbet	23,500	Lorient.	Building.
Jean Bart	23,500	Brest	"
Armored Cruisers.			
Edgard Quinet	13,644	Brest.	Under trial.
Waldeck-Rousseau	13,644	Lorient.	Launched Mar. 4, 1908.

THE NEW BATTLESHIPS.—Full particulars are now available of the battleships *Jean Bart* and *Courbet,* which are about to be laid down respectively at Brest and Lorient. The displacement of these vessels will be 23,467 metric tons, their length between the perpendiculars 541 feet 6 inches, their maximum beam 88 feet 6 inches, their mean draft 29 feet and their stern draft 29 feet 7 inches. The general features of their armament are well known. Eight 12-inch guns will fire right ahead and right astern, and ten on either broadside. The wing turrets will give the two guns in each an arc of fire of 180°, while the lower big gun turrets on the center line will range through 135°, and the upper turrets which fire over them through 140°. The design of the barbettes and turrets is such as to permit great rapidity of fire, each gun firing a round in 25 seconds. The secondary armament will consist of twenty-two 5.5-inch guns, of which 18, in groups of three, will be in a central battery protected by 7 inches of steel, while four others will be further aft in two casemates, one casemate on either quarter. The ammunition supply will be 100 rounds for each 12-inch and 275 rounds for each 5.5-inch gun. In addition to these guns will be four light pieces for boats and saluting purposes. The end to end belt will protect the bases of all the turrets and of the central battery, in association with three armored decks. The belt will be 10.6-inch thick amidships, tapering to 7 inches at the bow and stern, and the height of the belt above water will be 7 feet 8 inches, and its depth below water 5.8 feet. The conning-tower will be protected by 12 inches of steel, and the turrets by 10.6 inches. The intended speed is 20 knots with 28,000 I. H. P. The range at 10 knots, with 2700 tons of coal, will be 8412 miles; 760 miles at

full speed with normal coal supply, and 2280 miles with maximum supply. The machinery will consist of two groups of Parsons' turbines operating four screws and of water-tube boilers. Oil stoking will be provided for all boilers. The complement of the ships will be 941 officers and men. The actual construction will begin on August 1, but contracts for much of the work have been made already, and the ships are to be completed by August 1, 1913. About the middle of the second half of that year they are expected to be commissioned. These particulars are from the *Moniteur de la Flotte,* as are also the appended plans.



FRENCH BATTLESHIPS "JEAN BART" AND "COURBET."

THE FRENCH MANEUVERS.—Few, if any, French writers discuss naval matters with greater competence than the officer who writes under the name of Pierreval in the *Moniteur de la Flotte,* whose remarks upon the recent maneuvers are well worthy of study. He says it is natural to look in these operations for a formula of strategic doctrine, though he would wish it otherwise. The scheme represented the situation that would exist if the French fleet were opposed to the fleets of Italy and Austria seeking to unite. The Blue squadron represented a French squadron in such case, and that happened which might have been expected, the concentrated fleet and the most mobile attaining its object. The Red fleet based its operations on the intention of deceiving its adversary, and did not attempt to pass the Strait of Bonifacio because of the submarines. In relation to this matter the critic says it is extremely interesting to note the persistence of a theory often manifested in previous maneuvers, which consists in assigning to an enemy a fixed plan, and basing deductions upon the resulting

hypothesis. This continuity of views reveals, he thinks, the existence of a doctrine based upon the theory of penetrating the designs of the adversary, and then acting to the best advantage. Nevertheless, in war, things do not always happen as might be expected. The Blues did not hesitate to run through the Strait in spite of the submarines, and since no torpedoes were discharged and no guns were fired by the destroyers, it was not easy to know what damage would have resulted. The fleet steamed at a speed of 17 knots, running dangers which M. Pierreval thinks it would have preferred to avoid in actual warfare. He is inclined to believe that the idea of expectation and careful waiting prevails more than the offensive doctrine, not only in maneuvers but in the naval councils of the Republic. This latter conclusion is based upon the failure to include in the Navy Law ships of the *Indomitable* class. With reference to the second part of the maneuvers, which involved the passing of a convoy across the Mediterranean, he says that the result was the subordination of the proper objective to one that was secondary and in a manner accidental. The right procedure would have been to seek the enemy's forces and destroy them, instead of attempting to push forward the convoy before that object had been secured, not only because of the actual dangers, but because the enemy's fleet remained at large, having had time to unite with its friends, and thus it possessed the command of the sea. In regard to tactics, he says that movements in line have definitely taken the place of massed formations which were employed a few years ago, and adds that, though there is greater simplicity, there is still much to be learned, and maneuvers and exercises are the right school. It appears that there are two voices in the French Navy, the navigating seamen saying, "You must fire while we maneuver," and the gunners replying, "You must not maneuver while we are firing." The exact significance of this controversy does not appear in the article.—*Army and Navy Gazette.*

An extremely interesting maneuver has recently taken place in the Mediterranean by the French fleet. It was officially known as "Le thème a double action," and the scheme was as follows: A Blue squadron (Admiral de Jonquières) was required to assure the safe passage to France of two convoys of troops from Algeria; the first of these leaving Algiers, and the second leaving Oran. A Red squadron (Admiral Aubert), supposed to be coming from the Adriatic, was to oppose this operation. The business of Admiral de Jonquières was to reach Toulon with his convoy if he could; the business of Admiral Aubert was to sink or capture them en route. The fleet of the former admiral was the stronger and swifter, but it was hampered by the fact that after the declaration of war the supposititious transports were not allowed to move for twenty hours, during which time they were theoretically embarking troops and generally getting ready. Admiral de Jonquières had a flotilla at Toulon on the lookout for the enemy arriving from the eastward, and to them he sent a wireless message to watch Cape Corso, the northern point of Corsica, as it was fairly certain that the enemy must come north and not through the Straits of Bonifacio. The light squadron, under Admiral Pivet, had orders to cruise in the vicinity of Spartivento, the southernmost point of Sardinia, and at a fixed time, supposing the light division to have seen nothing of the enemy, it was to stand over to the southwest of the Balearics, where it would meet with the convoys; the flotillas from Algiers and Oran were stationed around the Balearics and the channels between the islands to observe the movements of the enemy. Admiral de Jonquières, with his squadron of six battleships, sailed at fifteen knots from Algiers to the Straits of Bonifacio, to block the passage of the enemy. Here he received information that his scouts had been chased by the enemy, which, in consequence, could not be far off. The admiral, therefore, quitted Bonifacio and stood over for his convoys, steering in such a manner as to intercept the enemy should be have rounded Cape Corso. He was followed by two destroyers and six

torpedo-boats of the enemy, three of which were judged to have been put out of action, while the remaining three delivered an attack at midnight half-way between Corsica and the Balearics. De Jonquières had ordered the light division and the Algiers convoy to rendezvous at Minorca, and the one coming from Oran at Cape Creux, to the northward of Barcelona on the mainland. Instead of steering from thence direct to Toulon, the admiral, who argued that his opponent would certainly string out his scouts on a line between Toulon and Marseilles, steered northeast, got to the southward, and eventually was successful in placing his convoy in safety under the guns of Toulon.

But here, again, Admiral de Jonquières had all the luck. "Le temps est toujours mauvais. Le Mistral souffle avec violence." Those who know what the Mistral can do in the latitude of the Gulf of Lyons will, in consequence, not be surprised to hear that the sea was so bad that the destroyers of the enemy were totally unable to keep the sea, and the results were as stated. The elements certainly fought for Admiral de Jonquières; at the same time all his dispositions seem to have been ably planned and carried out with remarkable care and attention by his subordinates; also it has to be remembered that at the present day there can be no duty entrusted to an admiral of so responsible and difficult a nature as that of the convoy of troops. It is interesting to learn also that on this occasion Admiral Pivet succeeded in sending off the torpedo-craft on a fool's errand by means of wireless telegraphy; they went off to attack a non-existent enemy.

These maneuvers, if they prove anything, only emphasize the fact that no one can dogmatize as to what is or what is not going to happen at sea, and it is probable that Admiral de Jonquières, able officer as he undoubtedly is, would be the first man to say that the most useful auxiliary he had in the task set before him was the bad weather, which prevented him from being located by the scouts of his enemy.

In the past it has been the unexpected which has so frequently disorganized the plans of the seaman of the sailing-ship era. There seems no reason to doubt that this will continue to be the case, for, even as the sailing ship could not get out of harbor in the face of the enemy if the wind were contrary, so in the present-day torpedo flotillas cannot keep the sea and perform efficient service when it is blowing a gale of wind.—*Naval and Military Record.*

FRENCH TARGET PRACTICE.—The second squadron of the French Mediterranean fleet has recently been making its annual target practice in a series of exercises known as the *tirs d'honneur.* The target was the old battleship *Fulminant,* and the mean range was 7000 meters. The target was stationary, while the ships firing were under way on courses indicated by the Director. The *Jauréguiberry* and *Dupetit-Thouars* were bracketed, with a percentage of 34 hits. The *Marseillaise* followed with 28, the *Condé* with 25, the *Bouvet* with 20, and the other ships with lesser percentages. The final classification is not, however, based upon the number of hits, but also upon the rate of fire, or at which hits are made, and in this relation the following were the results of the five best ships: *Dupetit-Thouars,* 24.3; *Bouvet,* 22.6; *Marseillaise,* 22.4; *Jauréguiberry,* 21.8; *Condé,* 20.8. The practice was inferior to the maximum of 1909, both in the achievement of the champion and in the mean of all the ships, which latter fell, in the final computation, from 17.8 to 15.3, or in actual hits from 21.6 to 20. On the whole, the practice was considered satisfactory, the circumstance being taken into account that the squadron had been incessantly occupied in cruising during the year on the coasts of Algeria, Tunis, Morocco, Portugal and Spain. This was very beneficial from the point of navigation, but did not give special facilities for gunnery.—*Army and Navy Gazette.*

GERMANY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Ost Friesland.....	19,000	Wilhelmshaven.	Launched Sept. 30, 1909.
Thüringen	19,000	Bremen (Weser Yard).	" Nov. 27, 1909.
Helgoland	19,000	Kiel (Howaldt).	" Sept. 26, 1909.
Oldenburg	20,000	Danzig (Schichau).	" June 30, 1910.
Ersatz Hildebrand ...	20,000	Kiel (Kaiserliche W.).	Building.
" Heimdall.....	20,000	Hamburg (Vulkan).	"
" Hagen..... ...	21,000?	Kiel (Howaldt).	"
" Aegir.....	21.000?	Danzig (Schichau).	"
" Odin.....	21,000?	Kiel (Germania).	"
Armored Cruisers.			
Von Der Tann	19,000	Hamburg (Blohm and Voss).	Under trial.
Moltke.....	21,500?	Do.	Launched April 7, 1910.
H.....	21,500?	Do.	Building
J	21,500?	Do.	"
Protected Cruisers.			
Kolberg.....	4,300	Danzig.	Under trial.
Koeln	4,350	Kiel.	" "
Augsburg.....	4.350	"	Launched July 10, 1909.
Ersatz Bussard.....	4,500 ?	Stettin (Vulkan).	Building.
" Falke.....	4,500 ?	Bremen (Weser).	"
" Cormoran.....	4,500 ?	Bremen (Weser).	Ordered.
" Condor.....	4,500 ?	Wilhelmshaven.	"

THE "OLDENBURG."—The latest German battleship constructed by the Schichau Shipbuilding Company of Danzig to replace the *Frithjof* was launched on June 30 and named *Oldenburg.*

The Lokalanzeiger gives the measurements of the new battleship *Oldenburg* as follows: Length, 492 feet; beam, 91.8 feet; draft, 29.5 feet; displacement nearly 20,000 tons, or considerably more than the displacement of the first German *Dreadnoughts.* She will have reciprocating engines developing 23,000 horse-power, giving her a speed of 21 knots. Her heavy armament will consist of 12-inch guns, instead of 11-inch guns as carried in the earlier *Dreadnoughts.* She will have altogether forty large-caliber guns. Her crew will number 960.

The interval between the laying down of the keel and the launching of the vessel was about a year. This constitutes a record for a German shipyard. The *Oldenburg* is to be completed for sea in April, 1912.

Up to now particulars regarding the *Oldenburg* have been withheld.—*Reuter.*

The foregoing figures relative to the *Oldenburg* are probably correct, and, if so, are another illustration of the exaggerations current concerning German warships—their number, size, power and rate of construction.

It is probable that the *Oldenburg* is merely an enlarged *Nassau,* carrying 12-inch guns in place of the 11-inch carried by the four ships of the *Nassau* class.

THE GERMAN NAVAL PROGRAM, 1911.—The correspondent of the *Tageblatt* has been giving some details concerning the German naval program for 1911, which seems to be incomplete as reported by the telegraphic agencies, and, therefore, it may be well to state exactly what are the features of the program so far as they concern that year. Three battleships are to be laid down, including one supplementary ship under the Novelle of 1908, these being to replace the *Weissenburg, Kurfürst Friedrich Wil-*

helm and *Brandenburg*, all of which were launched in 1891, two of them at the Vulcan yard at Stettin, and the other at the Imperial yard, Wilhelmshaven. In addition, the program includes another cruiser-battleship, to be denominated by the letter *K*. Thus four capital ships will again be put in hand as the work of the year; but, unless there should be another Novelle or supplement, the following year will see the laying down of two such ships only, and this will be the case up to the date of the completion of the present Navy Law. Besides the capital ships, the program includes two of the so-called small cruisers, which are every year growing bigger, and may well end by becoming armored cruisers. These will be to replace the old *Seeadler* and *Geier*. Finally, the program of the year will include 12 destroyers, being two divisions, and a number of submarines not yet indicated. In the building of vessels of the latter class the Germans long hesitated, but they have now a number of more or less experimental boats, and may be expected to pay a good deal of attention to this class of vessel in the future. The German Navy League has begun to agitate for a supplementary program, but there is some opposition to its ideas.—*Army and Navy Gazette.*

The battleship *Ersatz Heimdall,* recently laid down by the Vulcan Company at its new works at Hamburg, is to have modified A. E. G. turbines on three shafts. It is not expected that she will be launched before May next year. The sister ship, *Ersatz Hildebrand,* is being built at the Imperial Dockyard at Kiel.—*The Engineer.*

The designers of the *Von der Tann* have undoubtedly introduced into her some very striking features. Among these may be remarked the system of air ducts to the stokeholds which, in place of cowls or hooded ventilators, are arranged round the funnel bases in a manner that saves both weight and space. The pigeon-hole shape given to the inlet of these ducts gives a distinctly curious appearance to the vessel. Obviously the design of the *Blücher* has been widely used as a basis in designing the *Von der Tann.* The latter vessel has extremely clear decks, and Messrs. Blohm & Voss are to be congratulated on the success of the first vessel of the type of which they have three others—the *Moltke, H* and *J*—in hand.

The *Posen* is reported to have realized a speed of 20.5 knots in her trials, which is better than her sister ships did.

The 4300-ton *Kolberg* attained a speed of 27 knots.

The *Koln* and *Augsburg* will make their trials this autumn. They are sister ships of 4350 tons displacement, 426½ feet length, 46 feet greatest beam and a draft of 16½ feet. The crew of each will number 363, the speed will be over 25 knots and the coal capacity 900 tons. The trials of the two ships are being looked forward to with interest in engineering circles, as they are to be tested against the cruisers *Mainz* and *Kolberg,* in order to ascertain the merits of the different turbine systems in use in Germany. The *Koln's* turbines are Zoelly, the *Augsburg's* Parsons, the *Mainz's* Curtis and the *Kolberg's* Schichau.

During the coming winter a series of changes will be carried out in the organization of the German fleet. In the First squadron the *Wittelsbach* and *Zahringen* will be replaced by the *Rheinland* and *Posen.* The *Von der Tann* will replace the *Gneisenau,* and the latter will proceed to the Far East—though whether to relieve the *Scharnhorst* or to be added to the squadron there is not stated. The *Berlin* and *Königsberg* will be replaced in the Second and First cruiser groups respectively by the *Köln* and *Kolberg.* The *Hannover* will replace the *Wittelsbach* as second flagship in the First squadron.

The following list, based on all the available information, is an approximately correct statement of the probable completion of British and German ships of the Dreadnought type:

		Great Britain.	Germany.
Complete in August, 1910		Dreadnought.	Nassau.
		Invincible.	Westfalen.
		Indomitable.	Rheinland.
		Inflexible.	Posen.
		Bellerophon.	Von der Tann.
		Temeraire.	
		Superb.	
		St. Vincent.	
		Collingwood.	
		Vanguard.	
To complete in November, 1910		.....	Helgoland.
			Thüringen.
			Ostfriesland.
"	" February, 1911	Neptune.	.....
"	" March, 1911	Indefatigable.	.....
"	" May, 1911	.....	Moltke.
"	" August, 1911	Hercules.	.....
		Colossus.	
"	" December, 1911	Orion.	Oldenburg.
		Lion.	H.
"	" May, 1912	Conqueror.	Ersatz Heimdall.
		Monarch.	Ersatz Hildebrand.
		Thunderer.	
		Princess Royal.	
"	" July, 1912	.....	Ers. Aegir.
			Ers. Hagen.
			Ers. Odin.
			J.
"	" April, 1913	Five new ships.	.....

—*United Service Magazine.*

It is stated that during the German naval maneuvers in the autumn an attempt will be made for the first time to utilize an airship in connection with the operations. It will be fitted with an installation for wireless telegraphy, and its function will be to keep one of the combatants informed as to the other's movements. The aerial cruiser which will be used for the maneuver trials will probably be the new *Gross*, which has just been completed. It is considerably larger than any of its forerunners, having a capacity of over 80,000 cubic feet, a length of 305 feet, and a diameter of 42½ feet. There will be two cars, instead of only one, as in previous airships of this type, and each will contain a couple of 100-horse-power Koerting motors.—*Page's Weekly.*

GREAT BRITAIN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Neptune	20,250	Portsmouth.	Launched Sept. 30. 1909.
Colossus	20,250	Scotts (Greenock).	" Apr. 9, 1910.
Hercules	20,250	Palmer's (Jarrow).	" May 10, 1910.
Orion	22,500	Portsmouth.	" Aug. 20, 1910.
Monarch	22,500	Armstrong.	Building.
Conqueror	22,500	Beardmore.	"
Thunderer	22,500	London (Thames Iron Works).	"

Armored Cruisers.			
Indefatigable	18,000	Devonport.	Launched Oct. 28, 1909.
Lion	26,350	"	" Aug. 6, 1910.
Princess Royal	26,350	Vickers.	Building.
Australia	18,800	Brown & Co.	"
New Zealand	18,800	Fairfield.	"
Cruisers.			
Blanche	3,400	Pembroke.	Launched Oct. 27, 1909.
Blonde	3,400	"	" July 22, 1910.
Barossa	3,400	"	Building.
Barracuta	3,400	"	Ordered.
Liverpool	4,800	Vickers.	Under trial.
Dartmouth	4,800	"	Building.
Bristol	4,800	Brown & Co.	Launched Feb. 23, 1910.
Gloucester	4,800	Beardmore.	Under trial.
Falmouth	4,800	"	Building.
Newcastle	4,800	Armstrong.	Under trial.
Weymouth	4,800	"	Building.
Glasgow	4,800	Fairfield.	Under trial.
Yarmouth	4,800	London & Glasgow Co.	Building.

THE "LION."—The armored cruiser Lion was launched at Devonport on August 6. She is the fifth of the so-called *Invincibles,* armored cruisers of great size and speed, comparatively lightly armored, but carrying a battleship's armament of heavy guns, and primarily intended to protect British commerce in time of war by driving off the seas the commerce destroyers of the hostile nation. The *Lion* is much larger than her predecessors, having a length between perpendiculars of 700 feet, a beam of 88½ feet and a displacement (normal) of 26,350 tons. It is now known that the *Lion's* main battery will consist of eight 13.5-inch guns in four middle-line turrets arranged like those of the U. S. S. *Michigan* and *South Carolina.*

THE "ORION."—The battleship *Orion,* the eleventh British *Dreadnought,* and the first of a new class, was launched on August 20. She is of 22,500 tons displacement on normal draft, and will carry ten 13.5-inch guns in five turrets, all on the middle line, as in the U. S. S. *Delaware* class. Her speed is to be 21 knots and her full load fuel allowance 2700 tons of coal and 1000 tons of oil. She has three 21-inch underwater torpedo-tubes. Her main belt is 12-inches thick amidships.

The *Lion* is an old and honored name in the British Navy. A *Lion* was taken from the Scots in 1511. In 1563 another was in a squadron under Sir William Woodhouse. A *Golden Lion* shared in the contest with the Spanish Armada, and in 1596 was at the capture of Cadiz. In October, 1625, off the coast of India, a *Lion* was destroyed after a most desperate fight against large odds. Another *Lion* was at the battle of the North Foreland, June 2 and 3, 1653; and in May, 1655, she was at the capture of Jamaica. A *Lion* also shared in the British victory over the Dutch off Lowestoft, on June 3, 1665, and in 1667 she took part in a gallant and successful fight against the French at Martinique.

Thomas Foulis, captain of the *Lion,* was killed in the action with the Dutch on May 28, 1673. She was at the battle of Beachy Head on June 30, 1690, and also shared in the battle of Barfleur, in May, 1692.

In March, 1711, a *Lion* was commanded by Capt. Galfridus Walpole, who lost his arm in a gallant fight with French vessels; and on July 9, 1745, a *Lion,* of 58 guns, had a desperate action with a French 64, off the coast of Scotland. Two years later she was with Commodore Thomas Fox, in his successful attack on a large French convoy, and in October of the same year she was among the fleet under Hawke, off Cape Finisterre, when six Gallic war vessels were taken. *Lion* was also in Byron's force, which

encountered the French off Grenada on July 6, 1779, and on March 20, in the following year, *Lion* was one of three British which, when chased by five French, by mutually supporting each other, succeeded in beating off and escaping from their foes. Eighteen years afterwards—July 15, 1798—a *Lion*, 64, fought four Spanish frigates and took one of them. In March, 1800, she contributed considerably to the capture of the *Guillaume Tell*, French 80-gun ship, endeavoring to escape from Malta; and in 1811 she shared in the taking of Java. Our last *Lion* was launched at Pembroke in 1847, a sailing ship of 80 guns. Some years later she was altered and fitted with engines, but had very little sea service; in 1871 became training-ship for boys, attached to the *Implacable* at Devonport, and was sold out of the service in July, 1905.—*Naval and Military Record.*

THE "BLONDE."—The unarmored cruiser *Blonde* (of the *Boadicea* class) was launched at Pembroke dockyard on July 22. The keel-plate of the new vessel was laid on December 6, 1909, and her dimensions are: Length, between perpendiculars, 385 feet; breadth, 45 feet 6 inches; draft, forward 13 feet, aft 14 feet; displacement, 3350. Her engines are intended to produce 18,000 indicated horse-power, and her speed is estimated at 25 knots, but it is probable that this will be exceeded. The turbine machinery is being fitted by Messrs. Cammell, Laird & Co., of Birkenhead. Her armament will consist of ten 4-inch guns, a Maxim gun, and ten torpedo-tubes.—*United Service Gazette.*

An unarmored cruiser to be named *Barossa* was laid down at Pembroke on July 27. The new ship will be the fifth vessel of the *Boadicea* class to be built. In external form, except at the bow, and in the general feature of her structure, she will be identical with the *Blonde, Blanche* and *Bellona,* but will have six inches more beam, and 50 tons more displacement than the *Boadicea,* which was the first vessel of the class. She will differ from all the other vessels in having a ram bow below and an Aberdeen bow above water, whereas the others have the ram below, but are practically vertical above water. Some of the scouts have bows constructed on these lines, but that of the new ship will differ from them, because the upper part of her bow above water will extend beyond the foremost part on the ram, but does not do so in the scouts.—*Naval and Military Record.*

The *Moniteur de la Flotte* says the fifth and sixth of the *Boadicea* class are to be named *Active* and *Amphion* instead of *Barossa* and *Barracuta.*

AUSTRALIA AND NEW ZEALAND'S GIFT SHIPS LAID DOWN.—The building of the two *Dreadnought* cruisers for New Zealand and Australia respectively has been commenced. The Fairfield Shipbuilding and Engineering Company, Govan, have laid the keel of the vessel for New Zealand, and Messrs. John Brown & Co., Clydebank, that of the Australian ship. A good deal of preliminary work has been done by both firms since the orders were placed in the middle of March, but now that the vessels are actually on the stocks progress will be more apparent. They are to be completed early in 1912. Each is to cost about £1,800,000, and the orders were placed by the Admiralty in accordance with arrangements with the Governments of New Zealand and Australia.—*Naval and Military Record.*

TWENTY BRITISH TORPEDO-BOAT DESTROYERS ORDERED.—The Admiralty have now completed their prolonged negotiations with naval shipbuilders, and have placed the orders for the twenty torpedo-boat destroyers included in this year's naval program. Three additional vessels are to be built for the Colonial fleets, but so far this work has not been arranged for. Fourteen of the twenty boats for the Imperial Navy are to be of the *Acorn* class, designed by Sir Philip Watts, and being similar, will afford in fleet manœuvers the tactical advantage which accrues from corresponding speed and

turning circle, apart from the gain in the standardizing of the machinery. John Brown & Co., of Clydebank, will build three; two each will be built by J. S. White & Co., of Cowes; Cammell, Laird & Co., of Birkenhead, Hawthorn, Leslie & Co., of Newcastle-on-Tyne, and William Denny & Bros., of Dumbarton, while one is to be built by Vickers, Sons & Maxim, of Barrow-in-Furness, one by William Beardmore & Co., of Dalmuir, and one by Swan, Hunter and Wigham Richardson & Co., of Newcastle-on-Tyne, for which last-named the Wallsend Slipway and Engineering Co. will provide the machinery. These vessels are to be 240 feet long, 26 feet beam and of 770 tons displacement, the speed aimed at being 27 knots, which will require about 14,000 shaft horse-power. All of the vessels, excepting three to be built by Messrs. Brown, will have Parsons turbines. The three Clydebank vessels will be fitted with Curtis turbines, modified as a consequence of the extensive experiments carried out by Messrs. Brown's staff. A notable feature of all the ships is that they will carry two 4-inch guns, as well as a number of 12-pounders. In the case of the other six vessels, the contractors have been allowed a larger measure of latitude in the design of ship and machinery, although the speed and armament are the same. The contract for these vessels has been placed, for two each, with the Parsons Marine Steam-Turbine Company, of Wallsend-on-Tyne, J. I. Thornycroft & Co., of Southampton, and Yarrow & Co., of Scotstoun. The last-named all will be glad to recognize as again among the Admiralty contractors after an absence of several years. A feature in connection with these six vessels is the machinery. In all three pairs the contractors will fit machinery differing from that of the others and from that in any existing British destroyer; but it is desired that the actual details should not be disclosed because of the significance of the change. It may be added that the hull and boilers of the two vessels to be built by the Parsons Company will be constructed by Messrs. Denny, of Dumbarton.—*Engineering.*

The six destroyers of special type will doubtless afford some very instructive data upon their trials. It is understood that in each of the three pairs an important difference in the machinery will be made. It is stated that these experimental boats are to be propelled by twin-screws, driven in the case of Messrs. Yarrow's two by Brown-Curtis turbines; in the case of the Parsons Company's two by geared turbines of the Parsons type; while the remaining two will have another arrangement of Parsons turbines.

It is understood that in future all destroyers, while under construction, will be under the superintendence of a special captain-superintendent. The officer is to take over his new duties gradually. The trials and turning over of the vessels of the *Beagle* class are to be arranged by the existing superintendents, the new captain-superintendent being responsible only for the supervision of the fittings. Concurrently with this change the duty of supervising the construction at Barrow of vessels other than destroyers is to be transferred from the Admiralty Superintendent of the Clyde District to the Captain-Superintendent of the Tyne and Thames Districts.—*Page's Weekly.*

With the 27-knot torpedo-boat destroyers now under trial or being completed for service the following mean speed have been attained on the four-hour official trial:

Beagle	John Brown & Co.	Apr. 2	27.044
Harpy	J. S. White & Co.	Apr. 15	27.7
Scourge	Hawthorn, Leslie	May 25	27.03
Renard	Cammell, Laird	June 17	27.4
Wilverine	Cammell, Laird	June 18	27.2

The other vessels of the class are all well forward, the *Savage* and *Grasshopper* being prepared for commission at Harwich.

COST OF ENGLAND'S NAVY.—The First Lord of the Admiralty, Reginald McKenna, gave the House of Commons some interesting figures about the navy the other day. He gave the following figures showing the tonnage of the effective fighting ships of the navies of Great Britain, Germany and the United States at different periods:

	Great Britain.	Germany.	United States.
1880	664,388	145,500	Not known
1890	1,119,095	165,064	120,125
1900	1,889,614	293,461	209,300
1906	1,891,307	441,656	476,276
1907	1,885,966	447,820	547,222
1908	1,934,368	538,714	629,747
1909	2,046,126	544,073	706,107

From 1906 onward, second and third-class battleships, coast-defence ships and sloops, gunboats and subsidiary vessels have been omitted as not being effective fighting ships in the British list.

Mr. Clough, M. P., asked Mr. McKenna to state the total capital cost of construction and armament equipment of the *Indomitable, Invincible, Inflexible, St. Vincent, Collingwood, Vanguard, Indefatigable, Neptune, Colossus, Hercules, Orion, Lion, Princess Royal, Conqueror, Monarch* and *Thunderer;* what is the annual cost of maintenance and ammunition of each of these battleships, and what is the annual cost of maintenance and pay of officers and men of each of these battleships in full commission.

Mr. McKenna said that of the ships named the first six have been completed, and the following figures give the information required in regard to them:

Indomitable.—Total cost of construction, £1,662,940; total cost of armament, £90,000; annual cost of maintenance and ammunition, £58,200; annual cost of maintenance and pay of officers and men, £70,700.

Inflexible.—Construction, £1,630,740; armament, £90,000; maintenance, £58,200; officers and men, £70,200.

Invincible.—Construction, £1,676,250; armament, £90,000; maintenance, £58,200; officers and men, £70,950.

St. Vincent.—Construction, £1,581,735; armament, £142,400; maintenance, £58,100; officers and men, £68,450.

Collingwood.—Construction, £1,539,355; armament, £142,400; maintenance, £58,100; officers and men, £67,950.

Vanguard.—Construction, £1,462,270; armament, £142,400; maintenance, £58,100; officers and men, £67,950.

The cost of construction in the case of the *St. Vincent* and the *Collingwood* is liable to revision. As regards the remaining ships only estimated figures could be given, and it was not considered desirable in the public interest to give such an estimate at present.—*New York Sun.*

It is reported that one at least, and probably two, of the six "special" torpedo-boat destroyers being built under this year's program are to be fitted with geared turbines and twin screws. This will be an experiment of peculiar interest if carried into effect, because both speeds and powers are entirely out of the ordinary run, and the details of design of gearing for such conditions introduce some very difficult mechanical features.—*The Engineer.*

NAVAL TRAINING. HOW MIDSHIPMEN ARE TO BE INSTRUCTED.—*Combination of Two Methods.*—The Admiralty having had under consideration reports from ships carrying new scheme midshipmen, have decided to issue more precise instructions to supplement those contained in the Admiralty Letter of May 1, 1908. In that letter the general lines were indicated on which the training of midshipmen under the new scheme should proceed. It was pointed out that the training of midshipmen should be wholly of a

professional character, and that they should receive instruction from the executive officer of their ship in the general duties of a naval officer and in seamanship, and also instruction in gunnery, torpedo, navigation and engineering from the several officers who are specialists in these subjects. For the purpose of their training it was laid down that midshipmen were to work with the executive, gunnery, torpedo, navigation and engineer officers for continuous periods. The detailed appropriation of time was left, subject to certain provisos, with the commanding officer until experience should have been obtained. Midshipmen of the new scheme have now been at sea since May, 1908. Reports from the ships in which they are serving indicate that they are making satisfactory progress in acquiring professional knowledge, and this is borne out by the results of the examination held in November last. There is, however, as was to be expected, considerable diversity in the manner in which the midshipmen's instruction is carried out in different ships, and the Admiralty consider it desirable, in the light of the experience now acquired, to lay down more precisely the lines which should be followed, with a view to securing greater general uniformity. It should at the same time be understood that as regards details, the commanding officer is expected to exercise his discretion in directing the work of midshipmen, the object being to secure that when their sea service is completed they will be fit, without further instruction, to perform satisfactorily all the duties which may be required at sea of a sub-lieutenant or lieutenant, having a competent practical knowledge not only of seamanship and the general duties of an officer, but also of gunnery, torpedo, navigation and engineering. To this end, a combination of two methods should be employed in the training of midshipmen. They are to learn their work (a) by being attached to the several officers of the ship for definite periods, during which they will observe and take part in what the officers do in the performance of their several duties; (b) by means of systematic instruction in the several subjects in which the professional knowledge has to be acquired. This instruction is to be given partly by lectures or less formal tuition, and partly by making them carry out practical work which need not necessarily be part of the usual routine, but may be designed to serve an instructional purpose.

The Habit of Responsibility.—For the purpose of carrying out their instruction, midshipmen are to be divided into groups so that each of the specialist officers will have one or more acting under his direction for an assigned period; and each of the officers concerned is to be responsible for seeing that midshipmen so attached are usefully employed during that period in acquiring knowledge of his branch. Care is to be taken that the midshipmen engaged under any specialist officer in this manner not only see and take part in what he is doing, but understand the intention and character of the work on hand, the officer giving such explanations as may be necessary. It is highly important that they should learn early to assume the habit of responsibility, which is essential to the formation of their character as naval officers. Officers in charge are accordingly to endeavor to test their fitness for responsibility, and should not hesitate to delegate responsible duties whenever possible, at the same time watching the manner in which the midshipman acquits himself. Even if mistakes are occasionally made, this will be better than that officers should shrink from giving responsibility to the midshipmen. When they are first appointed to a ship on leaving the training cruiser, it is desirable that they should, in the first place, make a general acquaintance with the various departments of the ship before settling down to learn the work of the department in more detail. Accordingly, a first short period is to be spent in each department, and after this is over they will enter on a routine in which a considerably longer time is spent continuously in each.

Three Periods.—The Admiralty are of opinion that it is to the advantage of midshipmen not to spend the whole of their time in large ships. On first going to sea they will serve in large ships in which there are senior

midshipmen and in which a naval instructor is borne. In his second year each midshipman is to be transferred to another ship not carrying a naval instructor. The number borne in the latter ship will be comparatively small. Towards the end of his second year the midshipman will return for the third and final period to a ship with a naval instructor. These ships will be termed A and B respectively. The whole of the service will accordingly be divided into three periods, the exact length of which may be somewhat elastic, being subject to the discretion of the commander-in chief of the fleet in which the midshipman is serving. The commander-in-chief is to arrange for their transfers from A ships to B ships, and also their return to A ships, where they will spend their final year preceding the examination. The number of midshipmen nominally borne by each A ship will, when the scheme comes fully into operation, be about 24, of whom about eight will be lent to ships of the B class, leaving, say, 16 actually under training in the A ship at any one time. These will be of two seniorities, about half being in their first and half in their third year.

Those actually borne are to be divided into three sections for training in rotation in the three branches: 1, seamanship and general deck duties; 2, gunnery, torpedo and navigation; 3, engineering. When midshipmen first join an A ship from the training cruiser they will spend two weeks in each of the three branches in order quickly to make a general acquaintance with each. After this the period spent in each branch will be two months, each midshipman completing the cycle of the three branches in six months. Each section should have had two months of actual instruction in each branch before passing on to the next. After this cycle is completed, it is to be repeated, but with the period shortened from two months to one and a half months, or as much as may be necessary to secure that the cycle will be complete within the year. This is in order that midshipmen may have a second period of instruction in each branch before they leave the ship. In general, each of the three sections should include both senior and junior midshipmen, and as far as practicable seniors and juniors are to work together.

Attendance at Lectures.—Midshipmen will be required to attend the lectures on professional subjects in the several sections unless specially excused. This rule applies not only to lectures given by the executive and engineer officers, but also to lessons in navigation or other professional subjects given by the naval instructor. They may be excused from the naval instructor's lessons in navigation when they have, in his opinion, reached a sufficiently high standard and may be more usefully employed in other work. Lectures or lessons on the voluntary subjects of the syllabus are to be arranged for as far as may be practicable, but the attendance of midshipmen at such lessons will be voluntary. Midshipmen should be encouraged to select voluntary subjects of study, and should have whatever assistance can be given. In B ships a suitable place is to be reserved for study when the size of the ship admits of this being done.

Seamanship.—The commander is to be responsible for the work of Section I, and the following duties and subjects of instructions are included: Watch-keeping at sea and in harbor, boat-work, general evolutions, watch evolutions, divisional work under officers of divisions, watch, station and quarter bills, coaling ship and taking sights at sea. The instructions include rigging derricks, sheers, tackle, strains for wire and hemp, splicing wire, practical fitting of gear, maneuvering, general duties of the officer of the watch, organization including internal economy, berthing, messing, disposition of stores, summary punishments, etc.

Gunnery, Torpedo, Navigation.—Section II will include gunnery, torpedo and navigation, the gunnery, torpedo and navigating officers respectively being responsible. As a rule, there will be five or six midshipmen in the section, who should be divided into sub-groups to work with these officers, changing over at such intervals as will secure a more or less equal division of time. The officers responsible for the instruction of the midshipmen in

the several subjects are to arrange for such lectures or other formal lessons as may be necessary to give the midshipmen an opportunity of understanding the matter specified in the syllabus.

No attempt should be made to regard any part of the syllabus as matter to be crammed up for examination, but care should be taken that they have such a general comprehension of the various professional subjects as is required for the due discharge of their duty as naval officers, regard being had to the fact that they will be expected to qualify for the rank of lieutenant as a result of their sea service, without shore courses, and also to the fact that those who may afterwards be selected for specialization, will then have opportunities of acquirng further knowledge in the special branch. They are to work out the reckoning and take daily observations when the ship is at sea.

Engineering Duties.—Section III is for engineering, and midshipmen are to be regarded as members of the engine-room staff for the time being, and are not to be required to undertake extraneous duties. Their training will proceed chiefly by their taking part in the daily engineering work of the ship under the engineer officers, who are to arrange for supplementing this routine by such lectures as may be necessary. At sea the midshipmen of the engineering section will keep regular watch. They should begin by taking part in the routine, blowing down boilers, taking densities, making entries in the register, handling engines, taking indicator diagrams, to be worked out when off watch, looking after bearings, evaporators and auxiliary machinery. They should do the duty of stoker petty officer in the engine-room and stokehold, learning to take charge. They are to supervise the attends, attend to the cleanliness of the department, see valves worked and engines started and running, take notes of the work going on and make sketches of pipe leads and details of machinery. They are also to have an opportunity of obtaining insight into the adjustment of main and auxiliary engines.

It is not expected that midshipmen can at once undertake the supervision of engine-room artificers' work, but they should have as much opportunity as possible of gaining insight into it, so that with further sea experience they will be fitted to direct ordinary repair operations.—*Naval and Military Record.*

THE CANADIAN NAVY.—The plans for the creation of the new Canadian Navy are being completed without delay, and since we last referred to the matter Admiral Kingsmill has had an important conference with the home authorities in regard to details concerning the transfer of the *Niobe* and *Rainbow,* the lending of officers and men for instructional purposes, and the construction of the cruisers and destroyers which will join the Canadian unit. The *Niobe* will cross the Atlantic in September, and will be used for training purposes in the Gulf of St. Lawrence, with headquarters at Halifax. When she has served her period of usefulness in this capacity, it is intended that she shall become parent ship of the destroyers, six in number, whose construction from Admiralty designs will be begun in about a year's time, when it is expected that the necessary plant will have been provided. The destroyer force will remain at first concentrated in the Atlantic, but the four cruisers to be built will be divided between the Atlantic and Pacific seaboards. On the latter the *Rainbow* will be stationed for training purposes and for fishery protection duties. This vessel, which completed satisfactory gun and steam trials after refit at Portsmouth in June, is to leave for Esquimalt this month. As soon as the *Niobe* and *Rainbow* arrive on their stations recruiting will begin; in the meantime the Admiralty have agreed to lend the Canadian Government the necessary officers and men for the safe conduct of the ships. Halifax will also be the venue of the naval college, which will open in temporary quarters in October with a class of thirty cadets, although over 200 applications for admission to the college have been received. A competitive examination

under the Civil Service Commission will be held, adapted for boys of about fifteen years of age, and the successful candidates will undergo a two years' course in the college costing them about £100. They will then spend a similar period at sea as midshipmen, receiving pay at the rate of two dollars a day, out of which they must provide their uniforms and mess. They will then receive commissions as sub-lieutenants, with three dollars a day. In regard to shipyards and docks, Mr. Albert Vickers has visited the Dominion on behalf of his firm to consult with the Minister of Marine in connection with the establishment of dry docks and other equipment, and it is reported that the first yards will be constructed at Montreal, with docks at Quebec. Writing on June 29, the *Times* Toronto correspondent wrote that "plans have been approved for dry docks at Sault-Sainte-Marie, Ontario, and Vancouver, B. C." The former place would be convenient for vessels on either of the Great Lakes, but it is 900 miles further inland than Montreal.—*Army and Navy Gazette.*

THE "GLASGOW."—The first of the cruisers of the *Town* class has completed her trials, and the results are very satisfactory. The first vessel tried was the *Glasgow,* built by the Fairfield Shipbuilding and Engineering Company (Limited), Glasgow. She developed 22,500 S. H. P., and the speed on the measured mile averaged 25.8 knots, a speed which was maintained practically for the whole of the eight hours' full-power trial. On this test the boilers, which work under the closed stokehold system of forced draft, were using oil and coal, and the rate of consumption was equivalent to 1.6 pounds per shaft horse-power per hour—a good average result. The other steam trial was a thirty hours' run, divided into two parts—an eight hours' test at about eight-tenths the full power, and a 22 hours' run at about two-thirds the full power. The mean power developed on the former was 18,220 shaft horse-power, and the speed realized 24.9 knots, and on the latter 14,055 shaft horse-power, the speed being 23.7 knots.

The coal consumption on these trials was at the rate of 1.57 pounds and 1.61 pounds respectively per shaft horse-power per hour. These rates of consumption are very favorable, especially the latter—a point of interest, since these vessels are the first cruisers without separate cruising turbines. Instead there is introduced an extension at the high pressure end of the turbines for use only at low cruising speeds. The turbines, of course, are of the Parsons type, manufactured at Fairfield, and there are two high-pressure and two low-pressure ahead turbines, one on each of the four shafts, and the same arrangement of astern turbines.

The Glasgow has also passed through her gun trials. The ordnance includes a bow and stern 6-inch gun, five 4-inch guns on each broadside, two Maxim guns on the bridge, with two submerged tubes for firing torpedoes. An interesting feature of the class is that two are being fitted with Curtis turbines by Messrs. John Brown & Co. (Limited), of Clydebank, and the comparison of results, when these vessels are tried, will be specially interesting.—*Naval and Military Record.*

THE "LIVERPOOL."—The trials of the protected cruiser *Liverpool,* built by Messrs. Vickers, Sons & Maxim, have proved entirely satisfactory, the vessel exceeding her contract speed of 25 knots by 1.17 knots. Her coal consumption ranged from 1.57 pounds to 1.65 pounds per shaft horse-power per hour. On a 22 hours' run at about two-thirds of the full power the mean speed of the vessel on the Skelmorlie measured mile was 23.88 knots, the shaft horse-power of the turbines being 14,100. The coal consumption was 1.57 pounds per shaft horse-power per hour on an eight hours' trial. At about 80 per cent of the full power measured on the six runs on the mile the speed was 25.10 knots, the power being 18,824 shaft horse-power. The full power trial of eight hours' duration was run at a speed of 26.17 knots, the power developed being 24,178 shaft horse-power.

The vessel has been completed within 16 months from the date of the laying of the keel.

The *Liverpool,* as the name suggests, belongs to the new *Town* class, of which nine are being built, five of these, ordered early last year, are likely to complete their trials before the end of July. The vessels are of the light, protective-deck type, with high speed, moderate armament and great maneuvering power. They are 430 feet long between perpendiculars, 47 feet broad and at 15 feet 3 inches draft have a displacement of 4800 tons. The armament includes two 6-inch breech-loading guns—one on the forecastle and the other on the upper deck aft; ten 4-inch breech-loading guns—five on each broadside on the upper deck amidships; and two Maxim guns on the navigating bridge. There are also two submerged tubes for firing 18-inch torpedoes. Although the ships are unarmored, more than usually extensive arrangements have been made for ensuring the buoyancy of the ship in the event of the hull being perforated, by extensive subdivision of the interior; and there is extending right fore and aft a nickel-steel armored deck, sloping at the sides to well below the water-line. Under this deck there are extensive longitudinal and transverse bulkheads, the machinery, for instance, being distributed over five compartments, while the boilers are arranged in three compartments. The machinery is of the Parsons type, with four lines of shafts. A high-pressure ahead turbine and the separate high-pressure astern turbine are arranged on one shaft in each wing compartment, while one low-pressure ahead turbine, in which is embodied the low-pressure astern turbine, is mounted on each of the inside shafts in one central compartment, which also contains the maneuvering-gear for all the turbines. There is no separate cruising turbine, the principle being adopted of arranging for the admission of steam at several stages in the high-pressure turbine, according to the power desired. The economy obtained in the *Liverpool* would seem to indicate that this is a satisfactory arrangement. There are four propellers—one on each shaft. The auxiliary machinery and condensers are accommodated in two separate compartments abaft the main engine-room.—*Engineering.*

THE "GLOUCESTER."—H. M. S. *Gloucester,* the fourth of the second-class protected cruisers ordered under the program of 1908-1909, has just completed her trials, and Messrs. William Beardmore & Co., who built and engined the vessel at their naval construction works, Dalmuir, are to be congratulated upon the results, alike as regards the speed and machinery efficiency. The speed attained on the full-power trial was the best so far recorded for any ship of the class—namely, 26.296 knots, when the turbines were developing a collective power of 24.335 shaft horse-power, while the consumption of fuel was 1.14 pounds of coal and 0.42 pound of oil.

THE "NEWCASTLE."—The unarmored cruiser *Newcastle* has completed her steam, gunnery and maneuvering trials, with results which equal, and in some respects are superior, to those of the vessels of the type already tried. On her full power trial she made six runs over the measured course at St. Abbs Head, during the progress of the eight hours' test, and the speed averaged just over 26¼ knots, as compared with 25 knots anticipated in the design, the power developed by the Parsons turbine machinery being 24,669 shaft horse-power—2669 horse-power in excess of the designed power. The coal consumption trials, which gave equally favorable results, were specially interesting, as the *Newcastle* was the first cruiser tried without separate cruising turbines, the weight and space thus saved being utilized to add to the ordinary high-pressure turbines, at the high-pressure end, a series of stages to be used only at low powers. This change has justified the prescience of the engineer-in-chief, Sir Henry Oram, as on a 22-hours' run at 14,038 shaft horse-power and on the eight hours' run at 18,742 shaft horse-power, the coal consumption was about 1¾ pounds per horse-power per hour. Six runs on the measured mile on the former trial showed the

speed to be 23.24 knots for a mean power of 14,051 shaft horse-power, and on the latter trial 24.84 knots for 19,116 shaft horse-power. These speeds are in excess of those anticipated. The *Newcastle* proved an easily maneuvered ship, and the trials of the two 6-inch and ten 4-inch q. f. and five smaller guns gave satisfactory results. The *Newcastle* is 430 feet in length, 47 feet in breadth and at 15 feet 3 inches draft displaces 4800 tons. She is practically ready for commission.—*United Service Gazette.*

THE TRAINING OF NAVAL OFFICERS.—On the report stage of the navy votes being taken in the House of Commons, an opportunity was afforded of ventilating the views of those who are hostile to the new educational scheme. Mr. Barnes objected that the scheme was undemocratic. It used to be possible for a boy of humble parentage to get into the engineering branch of the service. Smart boys from the dockyards had been able to do it. Now the cost for a boy intended for service in the navy would be £100 per annum. He suggested that the Admiralty might do something to lessen the cost. Mr. Lee claimed that the scheme had the support of the great bulk of professional opinion. He agreed that boys of any class should be able to enter the navy as officers, and that £100 a year was beyond the reach of a large section of the community. He suggested that, as in the case of schools, a scholarship system might be instituted whereby every boy should have the opportunity of competing for a scholarship which would enable him to get his training and enter the navy without his parents having to provide a substantial sum. No great expense to the Exchequer would be involved. With regard to the stokers, in his view it was right that a body of men doing vital work and getting very little glory should have avenues of promotion opened to them such as the scheme provided.

IN REGARD TO THE QUESTION OF SPECIALIZATION IN THE NAVY.—Mr. McKenna thought the confusion which existed as to whether an officer who was an engineer specialist might become a gunnery specialist, and afterwards be ordered to resume his former duties, was on account of the word "interchangeability" having been introduced in the discussion. There was no such thing as interchangeability as between the different branches in the ordinary sense. The Admiralty had always disowned the word. Once an officer had specialized, whether as a gunnery, torpedo, navigating or engineer specialist, he would be a specialist in that particular class of work. Nothing he might do hereafter would disqualify him as a specialist, but engineer specialists would be in future, like the gunnery or torpedo specialists, executive officers. Just as a gunnery specialist was qualified to become a commander, a captain and an admiral, so a torpedo or engineer specialist would be equally qualified. The engineer officer would become an executive officer, with all the rank and right to promotion that any other executive specialist now enjoyed. There would not be any interchangeability between a gunnery lieutenant and an engineer lieutenant. The officer who had specially qualified as an engineer would, no doubt, be appointed to executive engineer duties, just as the gunnery officer was appointed to executive gunnery duties. There was a specialization of functions in the engineering class exactly as existed now with regard to gunnery and torpedo specialization.—*Page's Weekly.*

MIDSHIPMEN'S TRAINING. NAVAL HISTORY EXAMINATION.—The Admiralty have decided, in reference to naval history in the voluntary part of the examination for the rank of lieutenant, that in lieu of a written examination of the ordinary kind, midshipmen who select naval history as one of their voluntary subjects are to write an essay dealing broadly with the prescribed period. This essay, which is to be written during a midshipman's service at sea, should comprise, in the candidate's own language, a general survey of the period under review, but may, in addition, deal with any special aspect on which the candidate wishes to lay em-

phasis. Candidates should understand that they may use books of reference in preparing their essays, but copying from, or close following of, any writer is to be avoided. The essay will form the basis for marking, but it will be open to the examiner to submit candidates to a vivâ-voce examination if it is considered desirable, especially with the object of testing that the essay is in each case the candidate's genuine work. There will be no written examination. The essays are to be sent to the Director of Naval Education one month before the date of the candidate's examination for lieutenant.—*Naval and Military Record.*

An Order in Council has sanctioned the following: The payment of a special allowance of 6s. a day, as from January 1 last, to captains of the Royal Navy serving on the staff of the Royal Naval War College; a similar allowance at the discretion of the Admiralty to majors or captains of marines of five years' seniority who have passed the Staff College; and power to the Admiralty to grant the temporary rank of major to a captain of marines of five years' seniority when selected for the staff of the War College.

ADMIRALTY SURVEY WORK.—The report of the Hydrographer of the Navy for 1909 is a fine record of strenuous work performed both in home and distant waters by the surveying branch of the navy. In home waters the *Research* and *Triton* were engaged as usual, with the addition of a hired vessel, the *Argo,* and a steam launch, while abroad surveys were made by six naval small craft and one hired vessel. The whole force under the control of the Hydrographer comprised 83 officers and 825 petty officers and men, and of the former 58 were qualified surveyors. Some slight idea of the amount of work performed may be gained by examining the Parliamentary Blue-book, but this document does not state that the petty officers and men engaged in this important and strenuous work are not allowed one penny beyond their ordinary rates of pay. The officers qualified as marine surveyors are, of course, able to earn extra pay, and are believed to be satisfied with the scale. Many of the men do, it is true, volunteer for a commission in a surveying ship, but they have to work very hard on the surveying ground, and deserve extra pay. The officers and men of this branch surveyed during the year 932 miles of coast-line and sounded over an area of 13,938 square miles. This is an achievement highly creditable to the whole branch, and still more work would have been done but for an exceptional amount of foul weather in most quarters of the globe. In home waters Captain C. H. Simpson and his crew were largely engaged on the east coast of England and on the west coast of Scotland, while Captain W. P. Dawson and his staff were employed off the Orkneys and east coast. Captain B. T. Somerville, in the hired yacht *Argo* was also employed on the west coasts of Scotland and Ireland. In colonial waters, too, a vast amount of surveying work was accomplished that cannot be adequately noticed here, but we may mention that the *Egeria's* crew (Captain J. F. Parry) discovered, after an eight days' search, a pinnacle rock very dangerous to shipping, which had eluded all efforts in the previous year. This "Brodie Rock" consists of a very small pinnacle covered by 5 feet of water, and invisible to the navigator. It lies off Gabriola Beacon (British Columbia), and now appears on the Admiralty chart. Many useful plans and sketch surveys have again been sent to the Hydrographic office by navigating officers of the general service.—*Naval and Military Record.*

KEYHAM COLLEGE.—On July 31 the Royal Naval Engineering College at Keyham was closed as a training establishment for engineer officers of the old system of entry and education. At the prize distribution to the last batch of engineer cadets Sir Wilmot Fawkes distributed the awards. Reviewing its history, the admiral said that the college had had a com-

paratively short life of only thirty years, and yet what movements there had been in that time! In 1880, when it was opened, there were 770 engineer officers in the fleet, controlling an indicated horse-power of 600,000. At the present time there were 964 engineer officers in the navy, controlling an indicated horse-power of 6,000,000. He hoped those walls would in the future look down on good work well done, but that could never efface the work that had been done there in the past. The future use to which the college will be put is still uncertain. It will not be until April, 1913, that the first entries under the Osborne scheme will specialize in gunnery, torpedo, navigation, engineering or the marine branch. Assuming that, as seems to be generally expected, the new engineer officers will then take their advanced courses at Keyham, there remains an interval of more than two and a half-years, and, as we suggested last week, the plan of selecting a certain number of petty and warrant officers for higher courses of training with a view to their promotion to commissioned rank might be tried here during that time, if only on a small scale. It will certainly be a pity if no use is found for the college and its equipment until 1913, while the proposal we refer to might have results of the utmost value to the navy and the nation.—*Army and Navy Gazette.*

THE GREAT NAVAL MOBILIZATION.—Now that practically all the effective units in the home fleet are placed on a war footing as the result of the mobilization, it is opportune to consider the "striking" power and armored strength of the forces which will be engaged in the forthcoming maneuvers. Amongst the individual fleets the first division of the home fleet is naturally far and away the strongest. Reckoning the *Lord Nelson* and *Agamemnon* as *Dreadnoughts,* it consists entirely of vessels of this type, the aggregate tonnage being 164,450, and the armaments totalling seventy-eight 12-inch and twenty 9.2-inch. The second battle division is, of course, entirely homogeneous, and comprises the eight *King Edwards,* displacing 130,800 tons, and carrying thirty-two 12-inch, the same number of 9.2's and eighty 6-inch. The Atlantic fleet battle squadron is another force claiming the advantages of homogeneity, the six units being all of the *Formidable* class, totalling 90,000 tons displacement, and twenty-four 12-inch and seventy-two 6-inch in armament. The Mediterranean is not so fortunate, as four *Duncans* are associated with the two *Triumphs,* giving 79,600 tons of displacement, and an aggregate armament of sixteen 12-inch, eight 10-inch, forty-eight 6-inch, and twenty-eight 7.5-inch. The third and fourth divisions of the home fleet contribute the nine *Majestics,* four *Oceans* and the *Bulwark,* totalling 200,900 tons with fifty-six 12-inch and one hundred and sixty-eight 6-inch guns.

The armored cruisers also make a formidable array. None of the squadrons are homogeneous and to save a lengthy description the following table will be useful as a summary of their force:

Squadron.		Armament.			
		12-in.	9.2-in.	7.5-in.	6-in.
First	3 Invincibles	24	..	..	..
	1 Defence	..	4	10	..
Second	1 Shannon	..	4	10	..
	4 Warriors	..	24	16	..
Third	5 Antrims	..	..	20	36
	3 Cressys	..	6	..	36
	1 Drake	..	2	..	16
Fifth	2 Black Princes	..	12	..	24
	1 Drake	..	2	..	16
Sixth	2 Cressys	..	4	..	24
	2 Kents	..	..	..	24
	Total	24	58	56	176

Adding together the armaments of battleships and armored cruisers, the following striking totals are reached:

12-inch	230	970 (230 heavy, 348 above 9-inch).
10-inch	8	
9.2-inch	110	
7.5-inch	84	
6-inch	538	

Such figures as these, however, are of little value unless we have something with which to compare them. Let us, therefore, see what sort of comparison they make with the German Navy. The completed strength of the latter in sea-going battleships and armored cruisers is now thirty-seven—28 battleships and nine cruisers. That at once is an inferiority of thirty-one ships compared with our maneuvering fleet. The aggregate tonnage of the German fleet in armored ships is 448,903—354,829 for battleships and 94,074 for armored cruisers. The total tonnage of the maneuvering fleet will be no less than 989,800—665,750 in battleships and 324,050 in armored cruisers; or, from another point of view, 684,800 tons permanently in full commission and 305,000 tons brought up to full complement from the reserve. These figures have an interesting corollary. If the German Navy as it stands to-day were doubled—if its displacement increased from 448,903 tons to 897,806 tons—this would still be below the tonnage of the armored ships assembling for the forthcoming maneuvers. And here is another striking fact. The total gun power of the maneuvers fleets has already been given. Here is a similar analysis for the German Navy—all completed armored sea-going ships:

11-inch	112	632 (112 heavy; 158 above 9-inch).
9.4-inch	46	
8.2-inch	44	
6.7-inch	140	
5.9-inch	290	

In conclusion, attention may be drawn to the following age analysis of the armored ships engaged in the maneuvers: Ships completed in 1910, number, three; in 1909, three; in 1908, nine; in 1907, three; in 1906, six; in 1905, nine; in 1904, nine; in 1903, four; in 1902, eight; in 1001, four; in 1900, one; in 1898, one; in 1897, five; in 1896, one; in 1895, two.—*Naval and Military Record.*

In addition to the foregoing vessels (of which seven battleships and three armored cruisers are *Dreadnoughts*), there will also be a very large number of small cruisers, auxiliaries, depot ships, destroyers, torpedo-boats and, probably, submarines. To each of the first and second divisions of the home fleet is attached a flotilla of destroyers, twenty-five strong, and with each flotilla there are two scouts, a depot cruiser, and a fast vessel of the *Boadicea* type, carrying the senior officer. Each division has also a repair-ship, properly equipped for carrying out such repairs at sea as are not of a serious character; the first division has also a hospital ship, which will, of course, be at the disposal of the whole fleet. Its use will obviously be necessary, seeing that altogether between 60,000 and 70,000 men will be engaged in taking part in the maneuvers. The third (nucleus crew) division contains, besides the ships specified above, five protected cruisers, six torpedo-gunboats and four mine-layers, as well as three powerful flotillas of torpedo-craft. To the third division of the home fleet are also affiliated the principal flotillas of submarines—those at Portsmouth, Devonport, Dover, Harwich and Dundee. It is just possible that most, if not all, of these flotillas will be included in the scheme of the maneuvers.

Two points specially will be noticed in connection with these maneuvers. The chief one is that for the first time for several years the exercises are to be held in the Atlantic, where there will be no risk of any hostile feelings being engendered abroad; the other point is, that the Mediterranean

fleet for the second year in succession is being brought away from its station for the maneuvers. At the same time the lessons to be gained in the Atlantic are not likely to be of as much advantage as those that would accrue from maneuvering in the North Sea. Away there the fleets can practice all sorts of things undisturbed, with never an onlooker to distract or be indiscreet. Then, again, if the North Sea is to be the scene of the naval Armageddon, it is absolutely necessary for our men to get used to the coasts they will have to defend and the weather in which they will have to fight. North Sea training is, therefore, both convenient and necessary, but it is by no means pleasant, for of all the waters in which our sailors have to render service, those of the German Ocean are the coldest and least inviting, the rough seas and biting winds making of it a kind of naval purgatory.—*United Service Gazette.*

In the naval maneuvers which are about to commence over a million tons of armored ships alone will take part, and the conflicting fleets will present the most powerful force that has ever yet been assembled at one time under the White Ensign. The Atlantic fleet, under Vice-Admiral Prince Louis of Battenberg, will leave Gibraltar in company with the Mediterranean fleet, commanded by Admiral Sir Edmund Poë. The two fleets will make for the Lizard, where they will be met by the home fleet, and the maneuvers will then commence in earnest. Admiral Sir William May, commander-in-chief of the home fleet, will have supreme command of this great force, the total monetary value of which will be close upon one hundred millions sterling.

The main strength of a fleet lies always in its armored ships, and the following list shows the number and tonnage of the armored vessels which will be contributed to the maneuvers by the various fleets taking part:

Home fleet, first division—		
9 Battleships	164,450	tons
4 Armored cruisers	66,350	"
Home fleet, second division—		
8 Battleships	130,800	"
5 Armored Cruisers	68,800	"
Home fleet, third division—		
10 Battleships	149,100	"
9 Armored cruisers	104,200	"
Home fleet, fourth division—		
6 Battleships	78,750	"
Atlantic fleet—		
6 Battleships	90,000	"
3 Armored Cruisers	41,300	"
Mediterranean fleet—		
6 Battleships	79,600	"
4 Armored cruisers	43,600	"

Total: 45 battleships and 25 armored cruisers. Aggregate displacement: 1,016,950 tons.

The great naval mobilization of 1910 bids fair to be the most important ever carried out in the history of the navy. It has been the custom for some years past, as the naval maneuvers come round, to herald them with the statement that a "record" number of ships will be employed; but in this case we have perhaps reached the limit of our powers, the enormous number of 401 vessels being engaged in combined exercises, as against 374 last year. There is, save for the absence of live shell, little of make-believe about these periodical exercises of the fleet, and the work that is this year being carried out will be performed with that grim earnestness which is happily distinctive of the British Navy, when there is business of importance on hand. The real significance of this year's demonstration lies in the fact that it stands as a guarantee for the efficiency of the nucleus-crew

system, which has been so adversely attacked by the critics. So long as the machinery of mobilization is maintained at such a standard of effectiveness as has been shown, the complete success of this organization is assured.

Strangely enough, the mobilizing of this huge fleet, which makes that of any one of the great naval powers insignificant, and outnumbers and outweighs any possible combination of two of them at the present time, synchronizes with the fatuous appeal for a cool hundred million pounds to be spent in defensive work. Even were it practicable to raise such a sum, the nation generally would utterly deny the necessity. Indeed, with this great fleet before it, the people would rub their eyes and wonder what all the outcry is about. In the days of old, no one doubted that one Englishman was equal to two foreigners, and Sir Francis Drake had no hesitation in pitting his cockle boats against the great Spanish galleons. It looks now as if Britons have become so chicken-hearted that it requires two to stand up before one foreigner. In no other way can all the outcry be explained. And the worst of it is that such an expenditure would be utterly useless for the purpose. The suggested outlay on our part would be followed by similar expenditure by other nations, and so the insensate arming would go on until the burden would precipitate that war which it was intended to prevent. Timid people, whose minds are being unhinged by the bare possibility of an invasion, may find some consolation in the knowledge that even if the present German fleet were doubled, it would still have 70,000 tons less displacement than the British fleet now engaged in maneuvers.

For the first time the plan of operations, concerning which the most rigorous secrecy prevails, has been drawn up by the staff of the Naval Mobilization Department, a department at the Admiralty which was created in the autumn of last year. The circumstance, moreover, that these are the first grand maneuvers on a large scale to be held since Admiral of the Fleet Sir Arthur Wilson became First Sea Lord, could not but add to the interest with which they would be followed, were the secrecy removed. It has often been contended that it is a mistake to keep the public practically in the dark as to the work carried out during naval maneuvers, but it is considered that the exigencies of the situation demand the adoption of this course, and it must be admitted that the responsible authorities are the best judges as to what should be done in the matter. In these circumstances, it would be a mistake to place confidence in the reports that may come to hand during the progress of the maneuvers, though the discretion of the accredited journalist is surely as greatly to be relied upon as that of some of the eminent officers who have recently been airing their opinions, and bringing themselves into prominence in a manner that would do credit to a smart advertising agent.

The great value of these maneuvers lies in the fact that they are the culmination of the year's work in the divisional squadrons and fleets as regards war training. When ships are thus brought together a number of tactical exercises are held on the conclusion of the big strategical maneuvers, and evolutionary drills are carried out in competition. This produces a healthy spirit of emulation between the different ships' companies. With the officers, opportunity is taken to discuss points of professional interest, and those of one fleet interchange ideas with another. The flag officers and captains also obtain experience in the handling of large numbers of ships, which it is not possible for them to have at other times. Most important of all, the Admiralty authorities are given the opportunity of testing their war plans, and herein lies the key to the necessary secrecy which now obtains in regard to the scheme of operations. Sir Arthur Wilson is understood to believe in a system of strategy which is based on the widest possible sphere of action, and relies on large combinations in the open sea for its strength, so that we may assume that the practice which was followed while Lord Charles Beresford commanded in home waters of exercising in the North Sea and in Danish and Norwegian waters, is now discontinued.—*United Service Gazette.*

ITALY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Dante Alighieri	19,000	Gov't Yard, Castellamare.	Launched Aug. 20, 1910.
Cavour.	22,000	" " Spezia.	Building.
Giulio Cesare	22,000	Ansaldo-Armstrong.	"
Leonardo da Vinci ...	22,000	Genoa (Odero).	"
Armored Cruisers.			
San Giorgio.....	9,800	Gov't Yard, Castellamare.	Under trial.
San Marco	9,800	" "	" "
Georgios Averof.....	9,800	Leghorn (Orlando).	Launched Mar. 12, 1910.
Scouts.			
Quarto.....	3,600	Venice.	Ordered.
Marsala	3,600	Castellamare.	"
Nino Bixio.....	3,600	"	"

FOUR "DREADNOUGHTS" BUILDING.—The Naval Committee of the Budget has published an interesting report on the present condition of the Italian Navy, says the Rome correspondent of *The Globe.*

As regards the new *Dreadnoughts,* the committee states that all four of the vessels of this type ordered are now under construction. The first, the *Dante Alighieri,* will be commissioned in 1912, the *Giulio Cesare* and the *Leonardo da Vinci* in 1913 and the *Conte di Cavour* in 1914. All the other vessels under construction will be ready for service by December, 1912.

The report states that in August next the Mediterranean squadron will be composed of four divisions, made up as follows:

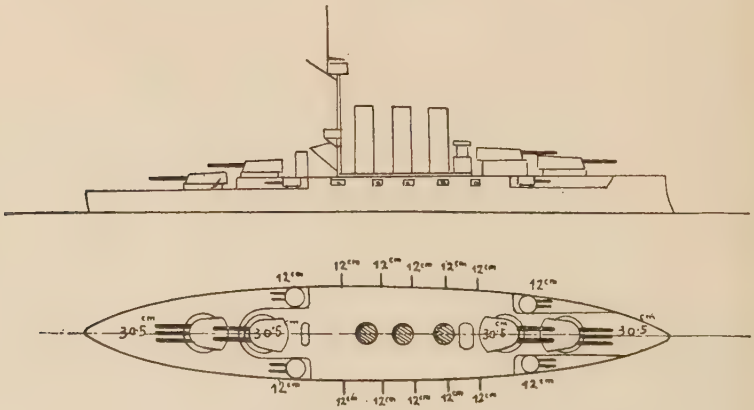
First division.—*Regina Margherita, Benedette Brin, Saint-Bon, Partenope.*

Second division.—*Regina Elena, Vittorio Emanuele, Napoli, Coatit.*

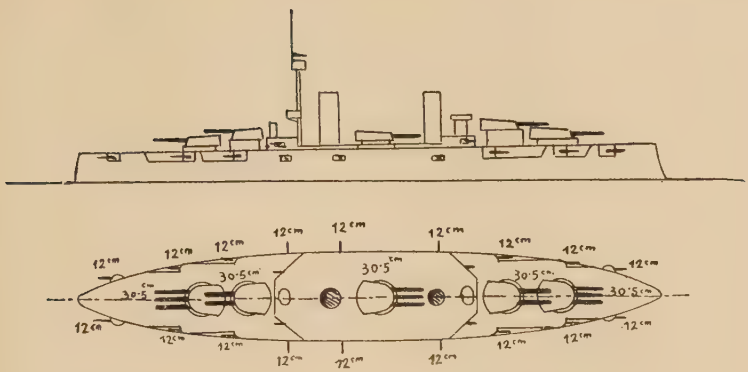
Third division.—*Pisa, Roma, Amalfi, Agordat.*

Fourth division.—*Garibaldi, Ferruccio, Varese, Tripoli.*

The appended diagrams showing the battery arrangements of the new battleships are taken from *Mitteilungen aus dem Gebiete des Seewesens.* The *Dante Alighieri* will be the first three-gun turret ship afloat.



"DANTE ALIGHIERI."



"CAVOUR," "GIULIO CESARE," "LEONARDO DA VINCI."

The latest rumor about the new Italian triple-turret ships is that the three guns will not be in line abreast, but that one gun will be above the remaining pair, so that the three form a species of triangle.

JAPAN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Satsuma	19,200	Yokosuka.	Under trial.
Aki	19,800	Kure.	Launched Apr. 15, 1907.
Kawachi	20,800	"	Building.
Settsu	20,800	Yokosuka.	"
Armored Cruisers.			
Kurama	14,600	Yokosuka.	Launched Oct. 21, 1907.
Protected Cruisers.			
Shikuma	5,000	Sasebo.	Ordered.
Yahagi	5,000	Nagasaki.	"
Hirado	5,000	Kobe.	"

The new year book gives the following as the existing number of officers in the various corps and grades of the navy:

	Line.	Engineer.	Medical.	Commissary.
Admirals	5	0	0	0
Vice-Admirals	23	0	0	0
Rear-Admirals	33	9	4	4
Captains	90	26	12	19
Commanders	182	49	39	42
Lieut.-Comdrs.	229	63	56	56
Lieutenants	552	206	111	70
Ensigns, 1st class	472	109	67	61
Ensigns, 2d class	328	114	29	25
	1914	576	318	277
Midshipmen	82	0	2	5
Total	1996	576	320	282

The ages of the admirals are from 57 to 67; of the vice-admirals from 41 to 56; of the rear-admirals from 42 to 53; and of the captains from 39 to 50.—*Le Yacht.*

The keel was laid at Nagasaki on April 25 of a Japanese destroyer of 1500 tons and 32 knots. The machinery is already nearly complete, and the vessel is to be ready for sea by April, 1911.—*United Service Magazine.*

RUSSIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Emperor Paul I	16,900	St. Petersburg.	Launched Sept. 7, 1907.
Andrei Pervozvannui	16,900	"	" Oct. 20, 1906.
Evstafi	12,500	Nicolaiev.	" Oct. 1906.
Ivan Zlatoust	12,500	Sevastopol.	" May 13, 1906.
Sevastopol	23.000	St. Petersburg (Baltic Wks.).	Building.
Petropavlovsk	23,000	" "	"
Poltava	23,000	" (Admiralty Yd.).	"
Gangoot	23,000	" " "	"
Armored Cruisers.			
Bayan	7,800	St. Petersburg.	Launched Aug. 15, 1907.
Pallada	7,800	"	Under trial.
Protected Cruiser.			
Outchakoff	6,750	Sevastopol.	Building.

THE NEW RUSSIAN BATTLESHIPS.—We have received from a correspondent in St. Petersburg the elevation, section and plans of the four battleships recently laid down—the *Sevastopol* and the *Petropavlovsk,* at the Baltic works; and the *Gangut* and *Poltava,* at the Obukoff works. The designs for these ships were prepared at St. Petersburg, where there is considerable discussion in official circles as to their merits and demerits. The drawings which we reproduce show the disposition and emplacement of all the guns of the main and auxiliary armament, and the system of armored protection.

The principal dimensions of the vessels are as follows: Length, 590 feet; breadth, 89 feet; mean draft, 27 feet 3 inches; displacement in tons, 23,000; shaft horse-power, 42,000; speed in knots, 23.

The outcome of the Russian experience in the war, and the examination of all the designs submitted in the competition of two years ago, together with the endless discussions which took place among the Russian naval authorities as to the type of ship best suited to meet all the conditions of modern warfare, has obviously resulted in a hybrid design, which discloses many serious inefficiencies from the fighting point of view. Taking first the arrangement of the guns, it will be seen that the main armament consists of twelve 12-inch triple-mounted guns, all on the center line of the ship, having arcs of training on both broadsides. Such concentration of fire within limited area has ever been regarded by experts as involving risks which can only be justified by indisputable advantages, which do not exist here.

As to the auxiliary armament of the vessels—sixteen 4.7-inch guns—the arrangement of these guns is such as to split them up into eight groups, each pair of groups being in close proximity to one of the main barbettes. When the 12-inch guns are being used in action, it will be impossible to use the 4.7-inch guns, over which the 12-inch guns may be firing, as the blast from three 12-inch guns will in all probability render the 4.7-inch casemates uninhabitable.

Coming next to the armored protection of the ships, it will be seen that the main belt armor protecting the machinery and the magazines is only 8.8 inches in thickness, which is not at all calculated to withstand the fire of the large-caliber guns being fitted to war vessels now building, and the still larger guns projected for vessels about to be laid down for navies to which the Russian ships would be likely to be opposed in combat. It would

seem that the idea was to protect every part of the above-water portion of the vessel with armor, irrespective of its thickness, so long as it could be termed armor, and thus the armored side is carried right up to the weather-deck forward. At the time the vessel was designed, it was intended to carry out the same arrangement aft, but our correspondent states that it was found that conditions of weight and the limit fixed for the displacement tonnage made this impossible, a fact which accounts for the after end—abaft the after barbette—being unarmored above the height of the main deck.

In the design, there is a complete departure from the idea adopted in Russian ships for many years—viz., that of submarine longitudinal explosion bulkheads against torpedo or mine explosions. There is in the new design only one longitudinal wing bulkhead on each side; it is of ordinary mild steel, and is dangerously near to the sides of the vessel.

There are fitted longitudinal armored bulkheads above the protective deck at a distance of about 11 feet in from the sides of the vessel, running from the forward barbette to the after barbette. These bulkheads are from 3 inches to 4 inches in thickness; the idea being to keep out any projectile from the interior after it has pierced the outside armor. The space between these upper armored bulkheads and the outside armor on each side of the ship is subdivided into water-tight compartments, the idea being that with such arrangement the vessel could always maintain her water-line area practically intact. Would the weight put into these bulkheads not have been much more effective if used for thickening the outside armor?

The arrangement of the rudders is notable. Each vessel is provided with two rudders, one placed immediately forward of the other in the center line. If the rudders had been arranged to carry out the idea for which they were first proposed—viz., to be placed so far away from each other that an explosion which would destroy one of them would be likely to leave the other intact—the arrangement would have been a good one. As a matter of fact, however, the crowding out of the internal space by magazines, machinery, etc., has resulted in the rudders being brought so close together that any explosion powerful enough to destroy one of them would probably at the same time render the other useless.

Another novel innovation is the ice-breaker stem, but it is of questionable utility. The shape is there, but no special strengthening for ice-breaking purposes has been made. The fitting of this stem has added considerably to the resistance of the vessel, on account of the virtual shortening of length, necessitating that the lines forward cannot in any possible circumstances be made as good for propulsive purposes as if the ordinary stem had been adhered to.

The designs for the guns and barbettes are purely Russian; and whilst giving no greater efficiency in any direction than in similar barbettes being constructed for other navies at the present time, the weight of each turret is close on 200 tons greater than in other types.

In order to keep the weight of hull and fittings as small as possible, it was decided by the Russian authorities that high-tensile steel should be used, it being apparently considered that on account of the greater tensile strength of this material it would be possible to reduce the scantlings throughout. This is an error, because, in many parts of the structure, stiffness has to be obtained where longitudinal strength does not enter very much into the question. The idea of weakness is borne out by the fact that in order to get the necessary longitudinal strength the beams of the upper deck have been placed longitudinally, so as to be taken into the strength calculation.

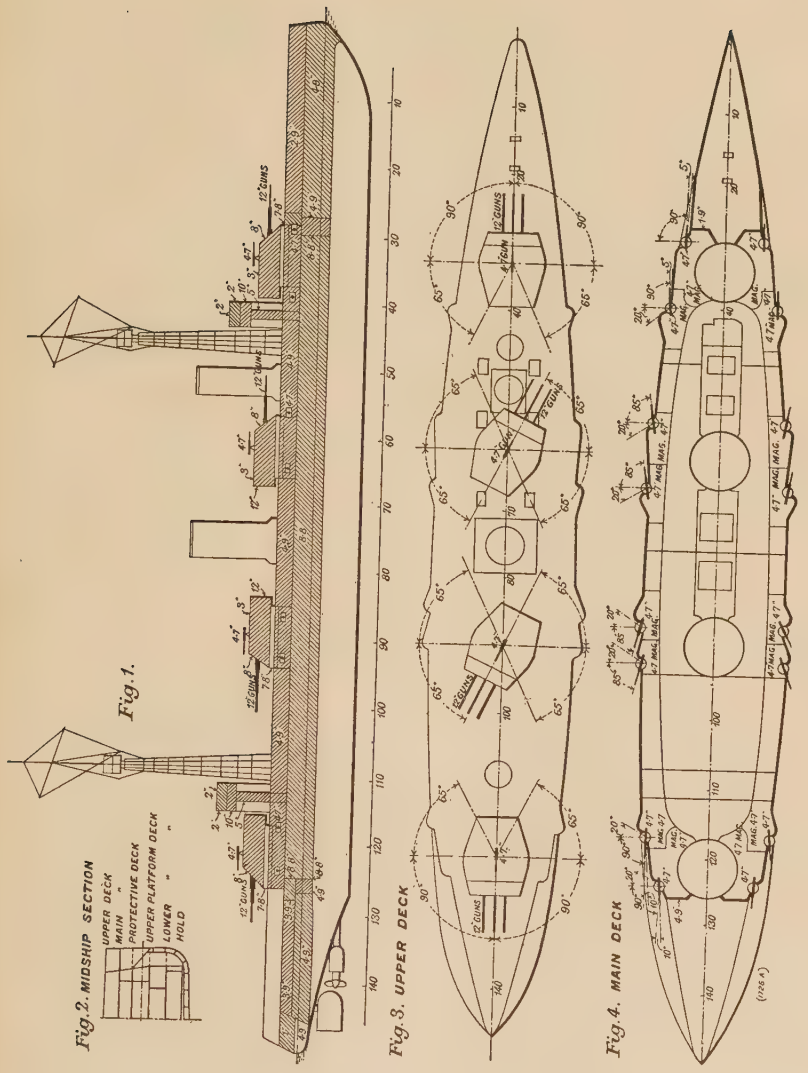
Having thus designed their battleships for 23,000 tons displacement, and having arranged for four such ships to be built, carrying triple barbettes whose weight was out of proportion to their efficiency, and having at the same time cut down on paper the hull weight to a dangerous figure, by assuming the use of high-tensile steel throughout, the keels were duly laid

down in two of the shipbuilding yards in Russia, and the work begun. At the very commencement it was found—as is usual in Russian naval construction—that there was a very serious hitch; so serious, indeed, that whilst these four vessels are supposed to have been building now for nearly two years, comparatively little work has been done on the hulls, except the laying of the keel-plates. The fact is that, according to the Russian laws, no material for these vessels, or for any other Russian warships, can be purchased outside of Russia, and Russian steel-makers were found to be unable, and without experience, to deal with the manufacture of high-tensile steel of the quality required. Thus the first quantities received in the various yards from the steel manufacturers were found to be incapable of meeting the tests demanded.

Coming to the question of machinery, the mechanical department of the Marine Technical Committee in St. Petersburg were desirous of having water-tube boilers of the large-tube type for the vessels, but on account of the necessity of keeping the weight of the machinery installation as small as possible, the advice of these experts was over-ridden, with the result that it was decided to fit water-tube boilers of the small-tube type. Further to this, discussion raged for many months over a proposal to fit Diesel oil-motors for cruising speeds in place of the ordinary turbines. Thus delay has occurred at every stage of the work on account of the wide differences of opinion as to the salient points to be embodied in the design, both in the hull, machinery and armament sections.

The Russian naval authorities were very sanguine at the outset that their four new battleships would all be delivered within three years, but knowledge of the conditions in Russia, as compared with those in England, where every detail is settled and all discussions as to the features of the ship concluded before the keel-plate is laid, justifies the view that the vessels in question cannot possibly be delivered for several years, and that their cost will greatly exceed the estimate. In support of this one has only to point to the battleship now being built in St. Petersburg, the *Andrei Pervozvannyi,* which has already been eight years under construction, and which has exceeded her estimated cost by over £1,000,000. When dealing with the question of cost, it should not be forgotten that the paper cost of a Russian battleship is always below the actual cost, because in the Armor-Plate and Gun-Manufacturing works, the charges of the works come under another and distinct vote to that for shipbuilding, consequently to the paper cost given for each ship there should be added the enormous working charges against those establishments.

To sum up the matter, it may be stated that the four Russian battleships now being constructed to the present designs promise to be of such doubtful efficiency as to suggest that their construction will be a waste of the country's capital. Strength of hull has been sacrificed to carry excessive weight of armament, so disposed as to risk a large proportion of it being rendered *hors de combat* under conditions easily realizable in warfare, while for the purpose of having machinery to give the ships the unnecessarily high speed of 23 knots, the boiler installation decided upon is, in its main features, contrary to general practice. The armor seems to have been arranged upon no sound scientific basis. The vessels are devoid of torpedo-tubes. Whether, for a purely theoretical advantage to her industries, Russia is wise in insisting that all her warships should be built in Russia, by Russian workmen, with Russian material, it is, of course, for Russia herself to say. The Russian industries and Russian workmen would, we are certain, benefit to a far greater extent than under present conditions if a design were accepted from any of the big warship-building countries, arranged, of course, to meet Russian conditions, but evolved from experience in naval construction, strategy and tactics, begotten by the building of the large and heavy vessels to meet modern requirements.—*Engineering.*



THE NEW RUSSIAN BATTLESHIPS.

SPAIN.

The Spanish Government has entrusted the work of reconstructing its navy to the Sociedad Espanola de Construccion Naval, a Spanish corporation organized for this special work, and having the great advantage of the technical guarantees of three of the most important naval construction companies in this country, and, therefore, in the world. These, in alphabetical order, are: Sir W. G. Armstrong, Whitworth & Co., John Brown & Co. and Vickers, Sons and Maxim. No three firms in any country have greater experience of the design and construction of modern war material.

This decision was arrived at as the result of international competition. The invitation to the warship builders of the world to tender for the reconstruction of the Spanish Navy appeared in the *Diario Oficial,* of Madrid, on April 23, 1908, in the form of a Royal Decree. It was there announced that the scheme should comprise not only the building of the ships, but the modernization of the existing arsenals at Ferrol and Cartagena.

At Ferrol, in addition to the new manufacturing establishments required, it was considered necessary to dredge the harbor, and to provide a new dry dock. The following amounts were estimated by the Government for this work, and were published in the invitation to tender:

	£
Ferrol—	
Three battleships of about 15,000 tons.....	4,620,000
Dredging of harbor.....	53,000
New dry dock.....	250,000
Other civil engineering work, building and machine plant	94,000
Total	5,017,000
Cartagena—	
Four gunboats of 800 tons.....	214,000
Three destroyers of 350 tons.....	224,000
Twenty-four torpedo-boats of 180 tons...	1,000,000
Total	1,438,000
Grand total	6,455,000

It is most creditable that the firm to whom the contract was awarded was able to more than fulfil the first requirements of the Spanish Government on the sum named; the small margin provided for contingencies enabled the builders to include a few improvements in the types of ships specified. The whole scheme was admirably thought out with a view of developing the resources of the dock yards, and at the same time fostering the industries of the country.

All the steel which is being worked into the hulls of the battleships building at Ferrol, for instance, has been obtained from Bilbao, and the same applies to the ships building at Cartagena, with the exception of a few cases where steel of special quality has had to be purchased abroad. Since the firm took over the works a large turbine-shop has been completely equipped for the manufacture of turbine machinery, and with two 50-ton overhead cranes, which, with the new machine-tools, are electrically driven. The workshops generally have been overhauled and brought up-to-date, and the foundry plant has been augmented by the addition of a new cupola of six tons per hour capacity. While the work on the new contract has been proceeding the fitting out and equipping of the *Reina Regente,* a new cruiser, has been accomplished, the vessel being now practically ready for trials. There has also been a large amount of repairs carried out, principally on the battleship *Carlos V.* Indeed, the only important parts of the ships' structure being purchased are the guns of large caliber, with their mountings, and the armor for the battleships.

Fig. 1.

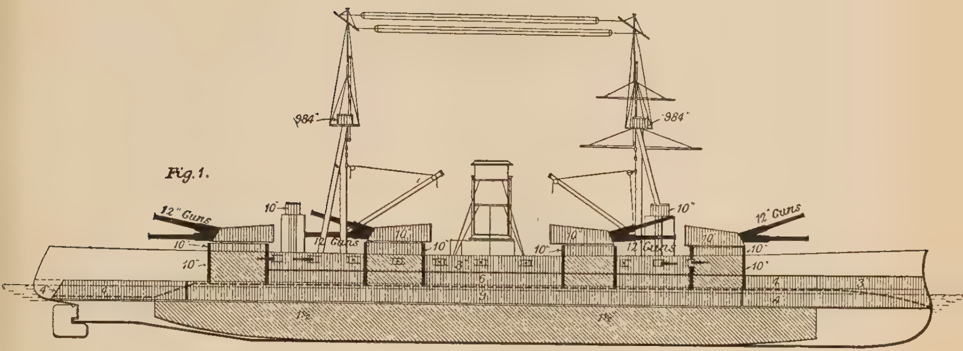


Fig. 2

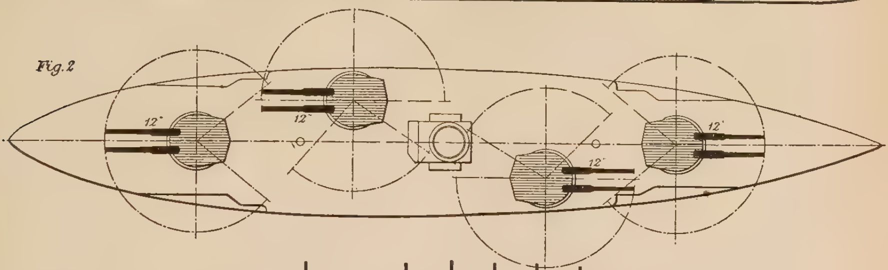


Fig. 3

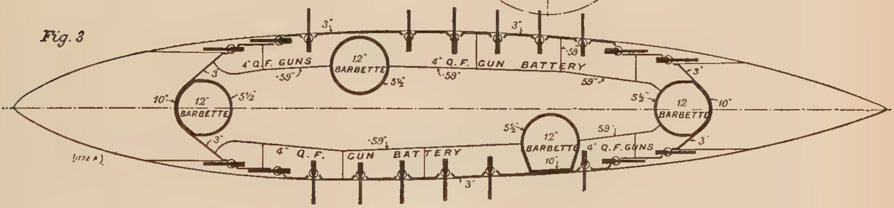
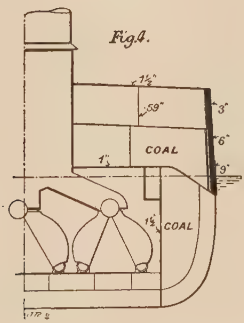


Fig. 4.



The battleships are to be named *España, Alfonso XIII* and *Jaime I.* They are 435 feet long between perpendiculars, of 78 feet 9 inches beam and 15,450 tons displacement on a draft of 25 feet 6 inches. Their speed is to be 19.5 knots and their radius of action 7500 knots. In referring in greater detail to their main features, as shown on the accompanying plans, the armament may take first place. The eight 12-inch guns, 50 calibers in length, have been so disposed as to get the maximum amount of training consistent with isolation of the magazines, and other desirable features. The mountings are all controlled by hydraulic power, and will be of the latest design, embodying the large experience of the builders. The auxiliary armament consists of twenty 4-inch guns, all mounted on the main deck behind the 3-inch battery armor. There are several smaller guns, but no torpedo-tubes.

The fire of the battleships' main and auxiliary guns will be controlled electrically from a central station placed below the water-line, the range being transmitted from the conning positions to this station, and from thence to the several guns engaged. Although the secondary armament is placed upon the main deck, the average height of these guns is over 13 feet above the water-line.

The disposition of the armor is clearly shown in Figs. 1, 3 and 4. Special attention may be directed to the under-water protection, consisting of a bulkhead, 1½ inches thick, completely protecting the machinery and magazine.

The machinery is of the Parsons turbine type, supplied with steam from Yarrow boilers. The turbines, however, are arranged somewhat differently from earlier practice, the turbines of all four shafts being in series. There are one high-pressure turbine, one intermediate and two low-pressure turbines, the last mentioned being on the wing shafts. The high-pressure turbine on the port inboard shaft exhausts into the intermediate-pressure turbine on the starboard inboard shaft, and the steam passes from the latter to the two low-pressure turbines. The inboard shafts have also high-pressures astern turbines, exhausting respectively into a low-pressure astern turbine within the same casing as the low-pressure ahead turbine on the wing shafts. The arrangement of the ahead turbines, it is anticipated, will largely reduce the steam consumption at all powers, without in any way affecting the simplicity of maneuvering gear.

The first ship, *España,* will be delivered in about three years' time, the second in four and a half years and the third in six years; but developments in warship construction were anticipated and embodied in the designs, and for their size the ships will rank with the best ships of other navies when they are delivered. There is every reason to believe that the dates above mentioned will be easily met, and perhaps anticipated.

The contract was signed at the end of July, 1909. Land had to be levelled, the ship berths made and piled, while contemporaneously new workshops were being erected and fitted with machine-tools and cranes. The keel of the first ship was laid on December 5, 1909, and that of the second ship on February 23, 1910.—*Engineering.*

UNITED STATES.

VESSELS BUILDING.

No.	Name. *Battleships.*	Speed. Knots.	Where Building.	% of Completion Aug. 1.
30	Florida	20¾	Navy Yard, New York.	71.0
31	Utah	20¾	New York Shipbl'g Co.	83.2
32	Wyoming	20½	Wm. Cramp & Sons.	32.3
33	Arkansas	20½	N. Y. Shipbuilding Co.	39.5

COMPARISON OF THE ARGENTINE BATTLESHIPS, "RIVADAVIA" AND "MORENO," WITH THE "WYOMING" AND "ARKANSAS."—*Navy,* June, 1910, gives a description of the Argentine battleships, translated from *La Nacion,* with

data revised and corrected to June 2, 1910, and a tabular comparison between these ships and the *Wyoming* class, on which it comments editorially, stating that "the superiority of the Argentine ships appears to extend to practically every detail." The comparison is incorrect in many respects and the comment shows prejudice as well as ignorance.

The following are the points of superiority cited:

(a) Shorter time of construction.
(b) Greater all-round volume of fire.
(c) Better protection.
(d) Two knots more speed.
(e) Substantially greater radius of action.
(f) Better fire control.
(g) Less cost.

Taking the items in order—

(a) Shorter time of construction:

Argentine battleships were contracted to be delivered in 24 and 27 months, respectively, against 32 months guaranteed in United States contracts.

Progress reports on the *Utah* (a 32-month contract) show that she will probably be completed six months ahead of her contract time. From signing of contract to delivery *Delaware* took 30.3 months; *North Dakota*, 32.2. From laying of keel to official trial in either case was 23 months.

(b) Greater all-round volume of fire:

This is the question of end-on *vs.* broadside fire and of center-line *vs.* echelon waist turrets.

The batteries of the vessels compare as follows:

Main Battery.—Argentine battleships, twelve 12-inch 50 caliber guns; United States battleships, twelve 12-inch 50 caliber guns.

Secondary Battery.—Argentine battleships, twelve 6-inch and twelve 4-inch R. F. G.; United States battleships, twenty-one 5-inch R. F. G.

Torpedo Tubes.—Argentine battleships, two 21-inch submerged; United States battleships, two 21-inch submerged.

The echelon arrangement of turrets has always appealed on paper, but the angles of fire on the off-side are generally disappointing; the gain in head-fire is always less than diagrams show, and it is worthy of note that the most confirmed exponent of echelon arrangement (England) has in her latest ships come to the center-line grouping.

In this connection, as affecting the handling of the battery, a comparison of the gun-heights and of the freeboards of the ships is pertinent. In the comparison given in the *Navy*, the freeboards and gun-heights are measured in each case from the trial load water-line, which is misleading, as the trial displacement of the Argentine battleships contemplates a smaller proportion of the total fuel, ammunition and stores, than in the case of the United States battleships. The change in draft of the Argentine ships from normal to full load is about 30 inches, and of the United States vessels 13½ inches. Referring the gun-heights and freeboards to the full load mean drafts as a more accurate basis of comparison, the figures become as follows:

Freeboards.	Argentine.	United States.
Forecastle	23′ 0″	23′ 10″
Midships	20′ 2″	19′ 2″
Aft	14′ 7″	16′ 3″
Turret No. 1	29′ 2″	28′ 3″
Turret No. 2	37′ 2″	36′ 3″
Turret No. 3	29′ 2″	32′ 11″
Turret No. 4	29′ 2″	24′ 11″
Turret No. 5	29′ 2″	31′ 3″
Turret No. 6	19′ 11″	23′ 3″

(c) Better protection:

In this statement the *Navy* is in error, as the following comparison will show:

Main Belt.—Argentine battleships: 8′ 1″ wide, 12 inches thick at top, tapered in about 2 feet to 5 inches at the bottom, reaching 3′ 4″ below normal water-line, extending over the machinery spaces and waist turrets and magazines, (about) 240 feet; beyond these at each end, reduced to 10 inches, tapered to 5 inches at bottom, (about) 76′ aft and 84′ forward in way of the forward and after magazines; at ends, 5 inches thick forward and 4 inches thick aft. The *Navy* states this 5-inch armor as 6-inch armor, but the above is according to our own information. United States battleships: 7′ 11½″ wide, thickness 11 inches at top, tapered to 9 inches at bottom, covers all turrets and magazines, 416 feet; aft, 5 inches thick, reaching 6 feet below normal water-line.

Upper Belt.—Argentine battleships: Thickness 9 inches at lower edge, tapering to 8 inches at the top, approximately same height as United States gun-deck, extending full length of heavy part of main belt, *i. e.*, about 400 feet. United States battleships: 11 inches at bottom, tapering to 9 inches at the gun-deck, extending full length of heavy main belt.

Casemate.—Argentine battleships, 6 inches thick; U. S. battleships, 6½ inches thick, backed up by splinter bulkhead on each side 1½ inches thick.

Smoke Stacks.—Argentine battleships, 1½-inch nickel-steel; United States battleships are protected up to main deck by 6½-inch armor and 1½-inch splinter bulkheads.

Protective Decks.—Argentine battleships: Two—upper, 1½ inches; lower, 3 inches. United States battleships: Two—over magazines; one elsewhere. Thickness not available.

Turrets.—Argentine battleships: Front 12 inches; sides, 9 inches; back, 11 inches; top, 3 inches. United States battleships: Thickness not available, but substantially identical with Argentine.

Barbettes.—Argentine battleships, 9 inches; United States battleships, 11 inches.

Under-water Protection.—Argentine battleships: 1-inch nickel-steel bulkhead extending throughout the magazine and machinery spaces, and ¾-inch nickel-steel flats beneath the magazine and machinery spaces. United States battleships: 1⅜ inches longitudinal special treatment steel bulkhead in way of magazines. There is, in addition, a watertight longitudinal bulkhead covering the extent of the magazines and machinery spaces which does not exist on the Argentine ships.

Conning Towers.—Argentine battleships: Two—forward, 12 inches; aft, 9 inches. United States battleships: One, substantially identical in thickness.

It will be seen that the main belt armor on the Argentine ships is thicker than that on the United States battleships only for about 240 feet amidships and only above and slightly below the normal water-line, while the upper belt and casemate armor is thicker on the United States vessels. The turrets are substantially identical, and the United States barbettes are 2 inches thicker than the Argentine.

(d) More speed:

Argentine battleships are to be 22½ knots on trial. United States battleships are to be 20½ knots, but the speed of the former when fully loaded will be reduced to a greater extent than that of the latter, owing to the greater change in displacement between normal and full-load condition.

The Argentine ships, although drawing a foot less in normal condition than the United States vessels, draw about 4½ inches more when fully loaded.

(e) Greater radius of action:

The cruising radius of the Argentine battleships is to be 10,100 knots, at 11 knots speed on coal only, while that of the United States battleships is to be over 8000 knots on coal and oil, at a speed of 10 knots. This difference

is obtained by the coal capacity of 4000 tons on the former as against 2500 tons on the latter, and an oil capacity of 660 tons as against 400 tons. The coal on the Argentine ships, however, is so stowed that the greater portion of this coal is difficult of access from the fire-rooms. It is doubtful whether there is actually as much coal readily available for use as in the case of the United States battleships.

(f) Fire control:

This is a matter of opinion. As a matter of fact, the arrangements on the United States ships were designed to suit the needs of the service as expressed by the sea-going officers, and it is to be assumed fulfill the requirements of the case.

(g) Cost:

Argentine battleships, complete, fully equipped for delivery, $10,665,300. United States battleships: The figure given in the *Navy* is $11,500,000 estimated. On this figure their criticism is based. This cost is evidently taken from a figure of $11,556,220 which was given in the testimony of the Secretary of the Navy before Congress. This figure was based on the estimated limit of cost for hull and machinery of $6,000,000. Taking the actual contract price for hull and machinery for the *Wyoming,* $4,450,000, and for the *Arkansas,* $4,675,000; this total cost would reduce to $10,006,220 for the *Wyoming,* or $10,231,220 for the *Arkansas,* as compared with the figure given for the Argentine ships.

In brief, reducing both ships to their full-load displacements, as these are directly comparable.

We find the *Wyoming* class to be 27,243 tons and the Argentine ships to be 30,200 tons. On this basis, we see that the United States ships, on 2957 tons less displacement and at less cost, have better protection, equal battery, equal or greater freeboard, less speed on trial, less radius of action. In other words, for greater displacement and cost, the Argentines obtain somewhat greater speed and greater radius of action, somewhat less protection and other qualities equal, which is about as it should be if the greater qualities obtained were the ones for which they wished to pay a greater price.

THE "FLORIDA" AND "UTAH."—The battleship *Florida* was successfully launched from the Brooklyn navy yard May 12. She is a sister ship of the *Utah,* which was launched from the yards of the New York Shipbuilding Company on December 23, 1909.

The keel of the *Florida* was laid in March, 1909, and the construction has progressed without delay in a most satisfactory manner until at the time of her launching she was about 69 per cent completed. Her over all dimensions are 521 feet 6 inches length and 88 feet 3 inches breadth, with a mean draft of 28 feet 6 inches when carrying a full supply of ammunition and a two-thirds supply of fuel and stores. On this draft her displacement is 21,825 tons. She carries 2500 tons of coal and 400 of oil fuel at full load. The outward appearance of the *Florida* will resemble greatly that of the *North Dakota,* with two smokestacks, two lattice observation masts and five turrets, each with two 12-inch 45-caliber guns, mounted on the center-line of the ship.

The machinery installation of the *Florida* will consist of steam turbines and water-tube boilers, together with the usual auxiliary machinery. The turbine machinery will be of Parsons type, and will consist of ten turbine units on four shafts, and will be arranged in such a way that one high-pressure ahead turbine and one backing turbine (both independent of one another) will be placed on the outboard shafts, and the low-pressure ahead and backing turbines (in one casing), together with the high-pressure cruising turbine on the port side and the intermediate pressure-cruising turbine and a low-pressure ahead and backing turbine on the starboard side, will drive the inboard shafts. As in most of Parsons four-shaft arrangements the outboard turbines turn inboard and the inboard turbines turn outboard. The engine-room has a central fore-and-aft bulkhead

dividing the engine power in two completely independent sections, each with complete sets of auxiliary machinery. The twelve Babcock & Wilcox boilers will be placed in three watertight independent compartments, each with a double fire-room.

The steam pressure at the boilers will be about 200 pounds, and 175 pounds at the throttle valve of the high-pressure turbines. As Parsons turbines do not operate advantageously with superheated steam, the boilers are not provided with superheaters.

When running full speed the revolutions per minute of the turbines will be about 330, and the horse-power developed about 28,000. It is understood the trial requirements of the *Utah* and *Florida* are to be similar to those laid down in the case of the *North Dakota* and *Delaware,* which had one 4-hour full-speed trial, one 24-hour endurance and coal consumption trial at 19 knots, and one 24-hour endurance and coal consumption trial at 12 knots. The maximum speed required of the *Florida* is 20¾ knots in a run of 4 hours.

Like the *North Dakota* and *Delaware,* the *Utah* and *Florida* carry ten 12-inch guns mounted in pairs in balanced turrets. The foremost pair of guns has an elevation of about 33 feet above the normal water-line. The second pair has a command of about 40 feet. The guns of turret number three have a command of about 32 feet, and those in numbers four and five of about 25 feet. All of the guns being mounted on the center-line, they can all be trained on either broadside. Dead ahead the *Utah* can fire four 12-inch guns, and the same number dead astern. This center-line disposition is probably the most effective that can be adopted.

The secondary battery consists of sixteen 50-caliber 5-inch guns. Eight of these are carried on the gun-deck within a central battery; four aft on the same deck; two in sponsons upon the main deck just abaft of the bridge, and another pair on the same deck well forward toward the bow. This gives a broadside of eight 5-inch and an end-on fire of four 5-inch ahead and astern.

The protection of the hull, both below and above water, and of the guns is exceptionally well worked out in these vessels, being in this respect an improvement even on the *North Dakota* herself, one of the best protected ships ever built. In the first place, with a view to limiting the destructive effects of a torpedo blow, particular attention has been paid to the question of cellular and compartmental subdivision. Even in the event of most serious underwater injury, such as might be done by a floating mine, the ship is able to concentrate on any compartment or set of compartments such a great capacity of pumps, that she would be able, by the aid of these alone, greatly to mitigate the effects of such a blow.

The armor plan of the *Utah* is probably the most complete and effective yet put upon any ship. The main belt, over 8 feet wide, has an average thickness amidship of 11 inches. Above this is a second belt 8 feet wide of an average thickness of 9 inches. The lower water-line belt is continuous from stem to stern, and the upper belt extends from the wake of the forward to the wake of the aftermost turret. The turrets of the 12-inch guns have from 12 to 8 inches of protection. The 5-inch secondary battery amidships is protected by 6½ inches of armor, and a similar thickness protects the casemates of the six guns at the bow and stern. Between each pair of 5-inch guns is a splinter bulkhead of 2-inch armor and back of each battery is a longitudinal wall of 3-inch armor, which closes in each 5-inch gun. To reach the base of the smokestacks any shell would have to pass through 9½ inches of armor—a superb protection.

The ship is provided with two of the new lattice-work fire-control masts. The handling of the boats is done by two boat cranes placed abreast of each other, one on either side of the after smokestack. In this ship, as in all United States *Dreadnoughts,* the officers are berthed on the main deck forward below the forecastle deck, the crew accommodation being aft. This places the officers near the bridge and conveniently to their post of duty.—*Royal United Service Institution.*

"WYOMING" AND "ARKANSAS."—The plans and specifications for battleships, No. 32, *Wyoming*, and No. 33, *Arkansas*, authorized by act of Congress, approved March 3, 1909, were completed and circular signed by the Secretary of the Navy, June 14, 1909, and issued to the bidders upon request thereafter.

The general dimensions and features of each vessel are as follows: Length on load water-line, 554 feet; breadth, extreme, at load water-line, 93 feet 2⅝ inches; mean trial displacement, 26,000 tons; mean draft to bottom of keel at trial displacement (about), 28 feet 6 inches; total coal bunker capacity (about), 2500 tons; coal and fuel oil carried on trial, 1993 tons; feed water carried on trial, 187 tons; speed on trial, not less than 20½ knots. Armament: main battery, twelve 12-inch 50-caliber breech-loading rifles, two submerged torpedo-tubes; second battery, twenty-one 5-inch rapid-fire guns, four 3-pounder saluting guns, two 1-pounder semi-automatic guns for boats; two 3-inch field pieces, two machine guns, 30 caliber.

Bids for the construction of the above vessels were opened at the department, August 18, 1909, and the contracts awarded on September 13, 1909, the *Wyoming* to the Wm. Cramp & Sons Ship and Engine Building Company, of Philadelphia, Pa., at a price of $4,450,000, and the *Arkansas* to the New York Ship Building Company, of Camden, N. J., at a price of $4,675,000, both to have the department's design of machinery installed.

The vessels are to be completed on or before the expiration of thirty-two months from the date of signing the contract. The contract for the *Wyoming* was signed October 14, 1909, and for the *Arkansas* September 25, 1909.

The percentage of degree of completion of the hull on August 1, 1910, was 32.3 per cent for the *Wyoming* and 39.5 per cent for the *Arkansas*.—*Army and Navy Register.*

ORDNANCE AND GUNNERY. TORPEDOES.

BRITISH BATTLE PRACTICE, 1909.—The result of the battle practice of the fleet in 1909 has been issued as a Parliamentary Paper (Cd. 5089). The Admiralty have issued the same document from the Gunnery Branch (No. 470). In a prefatory note the Admiralty state that the conditions of practice differed little from those of 1908, and that it is satisfactory to note the improvements in the results obtained. The following is an abstract of the results:

Fleet.	Ships.	Guns.	Average Points.	First ship.	Score.
China	5	70	348.68	King Alfred.	510.4
1st Division Home Fleet and 1st Cruiser Squadron	13	154	293.63	Boadicea	541.66
Mediterranean and 6th Cruiser Squadron	13	181	195.56	Conopus	459.82
3d Division Home Fleet	13	174	187.5	Sutlej	443.75
2d Division Home Fleet and 2d Cruiser Squadron	14	212	176.76	Warrior	320.31
Atlantic and 5th Cruiser Squadron	10	145	142.17	Argyll	401.78
Ships inside range	4	47	289.41		
Total, 1909	72	983	216.78		
Total, 1908	63	890	203.44		

BRITISH GUNLAYERS' TEST, 1909.—The Admiralty recently issued the result of the test of gunlayers with heavy guns in the fleet during 1909. (Admiralty Gunnery Branch, No. 467.)

Their lordships in a note to the document express their satisfaction that the standard of shooting which was attained in 1908, and which was in advance of that of former years, has been maintained, with the result that

the usual tabular statement is given showing the general improvement in marksmanship since the year 1900, and bringing out the circumstance that in 1905 an excess of hits over misses was first recorded with the old pattern target. An excess of misses over hits was registered in 1907 when the new target came into use but hits outnumbered misses in the following year, and the excess of hits was larger again in 1909.

		1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.
Number of ships that fired		121	127	139	134	108	100	89	121	117	116
Number of guns or turrets		1,031	1,137	1,241	1,296	1,171	1,096	1,073	1,365	1,277	1,312
Number of hits	1906 target	2,732	3,562	4,789	5,996	5,748	4,374	5,733	7,447	....	....
	1907 "	....	....	....	....	....	....	....	4,073	4,826	5,108
Number of misses	1906 "	5,709	6,244	6,863	7,028	7,664	3,357	2,328	1.991	....	....
	1907 "	....	....	....	....	....	....	....	5,465	4,183	4,330
Excess of hits over misses	1906 "	Nil	Nil	Nil	Nil	Nil	1.017	3,405	5.556	....	....
	1907 "	....	....	....	....	....	....	....	Nil	643	778
Excess of misses over hits	1906 "	2,977	2,682	2,074	1,032	1,916	Nil	Nil	Nil	....	....
	1907 "	....	....	....	....	....	....	....	1.392	Nil	Nil
Percentage of hits to rounds fired	1906 "	32.3	36.3	41.1	46.04	42.86	56.58	71.12	79.13	....	....
	1907 "	....	....	....	....	....	....	....	42.70	53.57	54.12
Hits per gun per minute:											
12-inch and 10-inch	1906 target	.30	.33	.38	.53	.47	.58	.81	.61	....	....
	1907 "	....	....	....	....	....	....	....	.40	.56	.63
9.2-inch	1906 "	.22	.31	.35	.70	.73	1.40	2.84	3.25	....	....
	1907 "	....	....	....	....	....	....	....	2.01	2.20	1.94
7.5-inch	1 06 "	....	....	....	....	....	....	....	3.48	....	....
	1907 "	....	....	....	....	....	....	....	1.58	2.51	2.47
6-inch B. L. and Q. F.	1906 "	1.51	1.81	2.41	2.63	2.63	4.14	5.68	5.93	....	....
	1907 "	....	....	....	....	....	....	....	3.32	3.98	4.03
4.7-inch Q. F. and 4-inch B. L. and Q. F.	1906 "	1.60	1.93	2.02	2.47	2.28	3.73	4.96	5.73	....	....
	1907 "	....	....	....	....	....	....	....	2.38	3.32	4.06
Number of ships from whom no returns were received		29	47	19	30	43	Nil	Nil	3	8	10

ABSTRACT, 1909.

Order of Merit.	Fleet or Squadron.	No. of Ships.	No. of Men Firing.	Points per Gun or Turret.	First Ship in Fleet.	Scores.
1	China	5	64	68.691	King Alfred..	79.21
2	Home Fleet, Third Division and Third Cruiser Squadron	26	291	49.872	Illustrious ...	64.27
3	Home Fleet, Second Division and Second Cruiser Squadron	15	208	48.613	NATAL	89.44
4	Atlantic Fleet and Fifth Cruiser Squadron	12	170	47.182	Albemarle ...	65.36
5	Mediterranean Fleet and Sixth Cruiser Squadron	14	186	43.810	Medea	61.34
6	Cape of Good Hope	3	29	41.984	Hermes	48.65
7	Australia	7	72	40.912	Encounter ...	62.06
8	Special Service, Tenders, etc	13	63	40.702	Bramble	62.37
9	Home Fleet, First Division and First Cruiser Squadron	16	186	37.188	Superb ..... / Temeraire....	71.21
10	Fourth Cruiser Squadron	3	24	33.554	Scylla.....	38.72
11	East Indies	2	19	31.720	Hyacinth	44.48
	Total, 1909 Test	116	1,312	46.098		
	Total, 1908 Test	117	1,277	45.775		

NOTE.—The 4-inch guns of the *Bellerophon* and *Invincible* classes are not included in this abstract.

LIGHT QUICK-FIRING GUN TEST.—The result of the test of the gunlayers with light quick-firing guns is prefaced by an abstract of the firing for five years, from which it is seen that the percentage of hits to rounds fired was: in 1906, 34.53; in 1907, 42.08; in 1908, 47.28; and last year, 50.13, thus showing satisfactory progress. The rate of accurate firing also shows improvement with all calibers of guns.

	1905.	1906.	1907.	1908.	1909.
Number of Ships that fired	86	89	122	111	104
Number of Guns	1,118	1,421	1,898	1,384	1,407
Number of Hits	1,228	4,666	7,462	6,120	7,157
Number of Misses	3,291	8,845	10,272	6,823	7,119
Percentage of Hits to Rounds fired	21.63	34.53	42.08	47.28	50.13
Hits per gun per Minute:					
12-pounders	2.12	3.417	4.471	5.319	6.005
6- and 3- pounders (except Vickers)	1.97	3.358	3.640	4.507	4.191
3-pounders, Vickers	....	8.144	6.140	6.069	7.810

12-POUNDER GUNS.
Abstract, 1909.

Order of Merit.	Fleet or Squadron.	No. of Ships.	No. of Men Firing.	Hits per Minute	Best Ship in Fleet.	Hits per Minute.
1	CHINA	4	36	9.182	Kent	11.32
2	Home Fleet, Third Division and Third Cruiser Squadron	12	132	7.485	SENTINEL	13.73
3	Home Fleet, First Division and First Cruiser Squadron	11	161	6.513	Minotaur	10.43
4	Home Fleet, Second Division and Second Cruiser Squadron	11	136	6.225	Forward	8.65
5	Mediterranean and Sixth Cruiser Squadron	12	137	5.152	Exmouth	7.53
6	Special Service, Tenders, etc.	6	38	4.995	Britomart	6.55
7	Atlantic and Fifth Cruiser Squadron	7	84	4.468	Arrogant	5.44
8	Australia	3	31	4.293	Encounter	6.55
9	Cape of Good Hope	1	8	3.409	Hermes	3.41
10	East Indies	1	8	2.455	Hyacinth	2.45
	Total, 1909	68	771	6.005		
	Total, 1908	76	863	4.471		

6- AND 3-POUNDER GUNS (EXCEPT 3-POUNDER Q. F. VICKERS).

1	Home Fleet, Third Division and Third Cruiser Squadron	18	96	5.069	HECLA	12.00
2	China	5	22	5.008	Bedford	8.36
3	Mediterranean Fleet and Sixth Cruiser Squadron	12	58	4.834	Duncan	7.27
4	Detached duty	1	10	4.691	Flora	4.69
5	Atlantic Fleet and Fifth Cruiser Squadron	8	63	4.519	Argyll	7.12
6	Home Fleet, Second Division and Second Cruiser Squadron	2	16	4.437	Sapphire	4.50
7	Australia	5	44	4.116	Challenger	6.91
8	Home Fleet, First Division and First Cruiser Squadron	6	40	3.900	Bulwark	6.18
9	Special Service, Tenders, etc.	8	30	3.164	Clio	6.00
10	Fourth Cruiser Squadron	2	18	1.879	Indefatigable	2.06
11	Cape of Good Hope	1	9	1.576	Forte	1.58
12	East Indies	2	8	1.558	Proserpine	2.18
	Total, 1909	70	414	4.193		
	Total, 1908	86	521	4.507		

NOTE.—Ships in capitals fired under special conditions for nucleus crew vessels.

LIGHT QUICK-FIRING GUN TEST AND DESTROYER BATTLE PRACTICE.—The Admiralty issued recently two further returns in connection with the gunnery practices carried out in the fleet during 1909. One of these returns gives the result of the test of gunlayers with light quick-firing guns (Admiralty Gunnery Branch No. 468); the other the result of battle practice from torpedo-boat destroyers (Admiralty Gunnery Branch No. 469). To each document is appended a prefatory note, in which the Lords of the Admiralty express their satisfaction at the improvement in the results as compared with those obtained in former years.

DESTROYER BATTLE PRACTICE.—A tabular statement prefixed to this return shows that whereas 139 vessels fired 6972 rounds in 1908 and made 4066 hits, 149 vessels fired 7896 rounds in 1909 and made 5130 hits. The percentage of hits to rounds fired was thus raised from 58.32 in 1908 to 64.97 in 1909. In the abstract of firing, the home fleet third destroyer flotilla stands first in order of merit; the first destroyer flotilla of the same fleet second; and the Mediterranean destroyer flotilla third.

A new world's record has been established by the marines' turret's crew of the *Temeraire* for 12-inch guns. During the gunlayers' tests of the home fleet recently Y turret fired eight rounds and obtained seven hits in 1 minute 21 seconds. The target was 18 feet square, and the range more than 2000 yards. The result of the firing with the 12-inch guns for the five turrets was 37 rounds, 29.5 hits. Admiral Sir W. May (the commander-in-chief of the home fleet) had the ship's company mustered on the quarter-deck, and congratulated the gunners on their remarkable shooting. —*United Service Gazette.*

THE QUESTION OF FIRE CONTROL.—The question of fire control in British armored ships is one that continues to exercise the brains and test the ingenuity alike, of our naval constructors and gunnery experts. The Americans sought to solve the problem of keeping fire-control instruments, and the officers who use them, at the necessary altitude to give them a large field of view, by introducing trellis-work masts. These masts, they argued, could not be shot away by one shell, nor could the fire-control platform be destroyed by one projectile, as was the case in the *Hero* experiments a couple of years ago; as part of the trellis work could be destroyed without bringing the control platform down by the run. But trellis-work masts have been found in practice to cause such a vibration on the platform at their heads, that to control gun-fire by instruments in such a position is impracticable. What is required, and what is being steadily evolved by our own gunnery specialists, is a system of controlling gun-fire from behind the ordinary armor of the ship, so that nothing short of the sinking of the vessel will deprive the gun-layers of the assistance they derive, by prompting, when firing at long distances. At moderate distances the gunlayers can direct their own fire by means of their telescopes, since they can see exactly where their shots are pitching, or hitting. Considerable success has been achieved towards the end of establishing control towers in foreign ships; but these are exposed to hostile gun-fire as a special mark; and to go lower still is the aim of our own authorities.—*United Service Gazette.*

An interesting account of the recent quarterly gun practice of the First squadron of the French Navy appears in *The Moniteur de la Flotte.* Battle practice was carried out in the Bay of Hyères, three large targets of regulation size being moored end to end, while the ships of the squadron steamed past them and back again at ranges varying between 5000 and 7600 meters. The ships were disposed in pairs and fired broadsides alternately, the whole period occupied being six minutes. In all, five pairs of ships took part in the practice, and although the targets were fixed, the courses steered were not made known to the gunnery officers directing the fire. The pair that made the best shooting under these conditions were

the battleships *Democratie* and *Verité,* securing 20 per cent of hits at the first broadside and 29 per cent at the second. At one period, it is stated, the two ships together secured 11 hits in 90 seconds, and at a range of 6000 meters. The *Democratie,* it may be remembered, beat all French records for shooting last year. Her captain and the captain of the *Verité* were congratulated by the Minister of Marine, who witnessed the practice. We learn, further, that practice with the smaller guns was carried out at night, the ships firing singly at two skeleton targets at ranges varying between 800 and 2000 meters, and the vessels steaming at 14 knots. The percentage of hits varied between 2 and 10 per cent, these poor results being attributed to the defective lighting of the targets.

No details are given as to the practice of the Second squadron, composed of older ships, except the statement that many of the shells burst prematurely. Since there were no accidents in this squadron it may be assumed that the fuzes were defective. In the First squadron serious defects developed in the guns and turrets of the *Justice* and *Patrie,* for we learn that five of the former's 19-centimeter guns were "more or less disabled," and one turret of the *Patrie* was put out of action by defects in the sighting gear. The damage to the guns of the *Justice* took a week to repair. On board the *Verité* a gunnery quartermaster was injured by back-fire, but there were no other casualties. These details are valuable, and may be accepted as having been officially inspired. The daylight battle practice of the First squadron was remarkably accurate as regards the two best ships, but details are lacking concerning the shooting of the other four pairs.—*Naval and Military Record.*

THE BIG GUN.—There can be no possible doubt that at the present moment the gun is ahead of armor. There has been no marked advance in the manufacture of armor-plate for a good many years, while the perforating power of guns of large caliber has increased very sensibly. And, in the experiments with the *Jéna* in 1909, firings at real fighting ranges demonstrated the exactitude of the figures that had been deduced from short-range firings at proving grounds. It is even known that the results obtained on that occasion surpassed expectations.

These facts have naturally led most navies to increase the thickness of the armor-belts on the latest ships they have laid down, a movement directly opposite to that which manifested itself a few years ago. Thus in England, after the *Lord Nelson* with 12-inch belt, the *Dreadnought* with 10.75 inches and the *Saint Vincent* class with 10 inches, they have gone back to 10.75 inches for the *Neptune* class and to 12 inches for the *Orion.* The Germans, from 9 inches on the *Braunschweigs,* pass to 9.4 inches on the *Deutschlands,* to 11 inches on the *Nassaus* and to 12 inches on the *Helgolands.* The Americans put 9 inches on the *Idahos,* 10 inches on the *Michigans,* 10.6 inches on the *Delaware* class and 11 inches on the *Wyoming* and *Arkansas.* In Italy, in Japan, development, though perhaps less pronounced, is in the same direction. France has followed the same road by going to 10.6 inches on the *Courbet* and *Jean Bart,* as on the *Patrie* class, after the 10 inches of the *Dantons.*

But impressive as these figures are, to appreciate their true value we must consider the actual perforating power of our 12-inch gun, model 1902: with oblique impact (18° angle of incidence) the new heavy projectile (970 pounds) will go through 18.5 inches of steel at 4000 meters, 16.1 inches at 6000 meters and as much as 14.2 inches at 8000 meters.

And this, be it understood, armor of the best quality, of which the resistance to penetration is about the same whether it comes from Krupps, from Vickers, from Bethlehem or from French armor-maker's works. So, too, the power of the guns of different nations is not sensibly different. And besides, it is to be remarked, the figures of perforation given above refer to a model of gun already outclassed, both in France and elsewhere—the *Danton's* guns, and especially those of the *Jean Bart,* would be still more effective.

It would appear, therefore, that we are very far from being able to give complete protection against gun-fire to the water-lines of battleships, either by sufficiently increasing the thickness of their belts (which would require a great increase of size), or by improvements in the manufacture of armor (an improvement that would have to be immense to be really efficacious).

Yet it is at this moment when the superiority of the gun seems so well assured, and for a long time to come, that on all sides there is question of adopting for the batteries of future ships a caliber greater than 12 inches. A 13.5-inch gun is talked of in England, a 14-inch in the United States, and even a 16-inch in Italy. Germany, that has but just, and not without regrets, given up the 11-inch gun that till now has been her largest, already thinks of advancing a step further; and it is known that our Superior Council, at its last session, called for the study, by the technical services of the artillery, of a type gun of 13.5 inches, with a view to its use on ships to be laid down next year.

We will neglect other points of view and consider here only the effect upon the military value of an isolated ship of increasing the caliber of her main battery guns.

We have seen that the perforating power of the 12-inch shell is superabundant. That of a similar 13.5-inch shell would be, uselessly, greater still. But without increase of this quality a gain of explosive power could be realized by increase of the bursting charge. The effects produced behind armor would, therefore, be greater. That is true, and it is even doubtless one of the best arguments that can be made in favor of the larger caliber, yet it is worth noting, first, that this increase of explosive power could be obtained right now with the 12-inch projectile by slightly thinning its walls, while still keeping sufficient strength for perforation. But the necessity of this increase, or even its utility, are not demonstrated. In the experiments with the *Jéna*, in fact, the careful observations made after each shot showed the importance of the damages caused by shell bursting behind the armor. And these results were obtained with shell with bursting charges not exceeding 3 per cent of their weight. There is, therefore, no apparent object in carrying more explosive through armor.

Would the chances of hitting be increased?

Purely from the ballistic point of view, these chances depend on the velocity of the projectile, and we may say at once that the initial velocity would not be increased. But on account of its greater weight, the larger projectile would retain its velocity better, and the danger space would consequently be increased. Therefore, the effect of an error in the range would be lessened, and in the approach of two adversaries there would be less frequent need of changing the sight elevation. This advantage would be especially appreciable at very great ranges, beyond 8000 meters, where the danger space might increase from 400 to 450 or perhaps 500 meters. Only, 8000 meters is a distance at which range-finders as they now exist, perfected though they have been in recent years, give but very uncertain results; the errors of measurement exceed not only the gain of danger space, but, if atmospheric conditions are not favorable, even the whole extent of this danger space. Perfect range-finders—which we may have some day, but which are not yet in sight—would be needed to give this advantage any practical value.

It may be said, it is true, that its importance might be increased by adopting higher initial velocities. But for that it would be necessary to accept an increase of the powder pressure and a lengthening of the bore. This would bring about, first, perhaps insurmountable difficulties of manufacture, and then risk of erosions that would sensibly diminish the lifetime of the guns. As a matter of fact, it seems likely that the principal object sought in England in adopting a 13.5-inch gun is precisely to diminish this erosion by keeping a charge of the same weight as that of the 12-inch, that is by diminishing the pressure. The Admiralty is disturbed, and not without reason, at the rapid wear caused by their nitro-glycerine powder. In France, where, alone of all navies, we have been able for three years past

to use full charges in all our target practices, experience teaches us that there need be no fear on that score.

Compared with the doubtful advantages that we have just considered, the disadvantages of the greater caliber are numerous and evident.

The guns are heavier, the turrets must also be so, and likewise all the apparatus required to operate them. Whence, on a ship of given displacement, diminution of the number of guns (eight 14.5-inch, or ten 13.5-inch, in place of twelve 12-inch), or, if the same number of guns is kept, a considerable augmentation of size and cost. To say nothing of the very serious technical difficulties that will be encountered in the working out of double turrets for 13.5-inch or 14.5-inch guns and their installations.

The projectiles are heavier (970 pounds for the 12-inch, 1366 pounds for the 13.5-inch, 1763 pounds for the 14.5-inch). Whence, diminution of rapidity of fire and consequently inferiority to the 12-inch gun is so far as fire intensity is concerned; whence also greater difficulty of fire control on account of the less number of points of fall; whence, finally, probable impossibility of hand working the ammunition hoists in case of damage to the mechanical appliances.

None of these faults is to be despised. They doubtless are what makes the naval authorities of all countries hesitate. For in reality it appears that no nation has yet adopted for its new ships a caliber greater than twelve inches.*

If, however, one of them decides to do so, ought we follow suit? We do not think so.

In the actual state of the science, the 12-inch gun is more than a match for any resistance that can be opposed to it, and that too at the extreme ranges at which opening fire seems possible under favorable conditions. Even if the clearness of the atmosphere and the perfection of range-finders permit firing from still further off, at 11,000 or 12,000 meters for example, the advantages of the 13.5-inch gun, or a still bigger gun, do not appear to us sufficient to balance their disadvantages. For an equal number of guns, it does not seem to us that a battleship armed with 12-inch should be inferior to one armed with 13.5-inch guns, and it will cost less, which is a matter of importance. Let us hope that our navy will not initiate a change the benefits of which are more than doubtful, and that we shall even be able to resist the temptation of imitating what foreign nations may do in this direction.—*Henri Bernay, in Le Yacht.* (Translated by P. R. A.)

A NEW HOWITZER SHELL.—For several years past the artillery authorities of the French and German armies have been experimenting with a view to obtaining a "universal" artillery projectile, which shall be effective both as a shrapnel and a high explosive shell. The Germans have been the first to realize this ideal by the introduction of a universal shell for their 4.2-inch field howitzer equipment. This shell is of the type patented by Messrs. Ehrhardt, and is, in effect, a shrapnel with a high explosive burster of picric acid in the head. It has the ordinary arrangement of bullets and diaphragm, with a driving charge in the base, but the bullets are packed in trinitrotoluol instead of resin. When the shell is burst in air by the time fuse, the flash from the fuse is led through a channel containing perforated pellets of compressed powder. This channel passes round the high explosive burster, without communicating with it, and leads the flash to the central tube communicating with the black powder charge in the base of the shell. The bullets are then blown out in the ordinary manner, except that the trinitrotoluol among them takes fire and burns without exploding, producing a cloud of smoke which increases the visibility of the burst. The head with the high explosive charge is blown off, and flies forward, bursting on striking the ground.

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* As a matter of fact England has launched two ships, *Lion* and *Orion*, that will carry 13.5-inch guns; and the United States is about to lay down two that will carry 14-inch.—P. R. A.

When the fuse is set to burst the shell on percussion, then the percussion part of the fuse acts upon impact, and the flash from the cap passes to a primer of fulminate, which detonates an exploder of gun-cotton powder, which, in turn, detonates the main picric acid charge. The intention is that the detonation shall also be communicated to the trinitrotoluol among the bullets. But it would appear that this cannot be reckoned on with certainty unless the shell strikes on rock or hard ground. However, even if the picric acid alone detonates, the effect is to burst the shell violently, blowing the bullets and fragments in all directions, even to the rear, so as to take in reverse men behind gun-shields or parapets. When burst in this manner the shell explodes instantly on impact, producing only a small crater, and giving little breaching effect. When it is desired to attack casemates or to breach parapets, the fuse is set before firing to "delay action." By moving an index on the head of the fuse, the flash from the percussion part of the fuse is diverted to a channel in which a short column of compressed powder is interposed, so as to give a delay of a quarter of a second before the flash reaches the fulminate and detonates the burster. This enables the shell to bury itself before bursting; the man-killing effect is then insignificant, as the splinters remain in the hole, but the mine effect is very powerful.

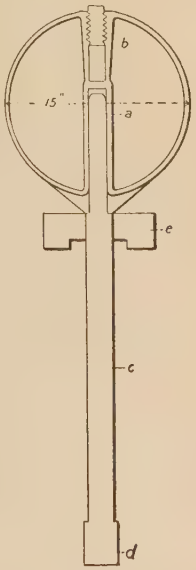
The universal howitzer shell contains 38 per cent of bullets as against 50 per cent for ordinary shrapnel. It is thus less efficient when burst in air. It has, however, this advantage, that the trajectory can be corrected by observing the fall of the head, which explodes when it strikes the ground. But the great advantage of the new projectile is that it renders a greater number of shell available for any particular nature of fire, since it is efficient against any target, and especially against shielded guns.—*The Engineer.*

RACE BETWEEN GUN AND ARMOR.—We are once more reminded that finality is as far off as ever in the production of guns and armor, by the fact that scarcely have the praises of a new and more powerful gun for our battleships been sung, than we hear of a process for the further hardening and rendering more effective the armor plates that clothe the sides of these mammouth sea fabrics. Thus the eternal race between gun and armor continues as vigorously as ever. The 13.5-inch guns which have recently passed some very severe tests successfully, will in all probability be introduced into those of our battleships whose keels have just been laid as part of last year's program. In passing, it may be mentioned that the Germans, who have stuck so tenaciously to the 11-inch gun as the primary weapon of their battleships, also have a 13.5-inch naval gun under trial at Essen, so that our rivals are treading close upon our heels in gun production. Happily the new process for further hardening armor plates is the discovery of a Britisher, and the Admiralty are said to have secured the patent and are arranging a series of severe tests for plates produced by the firm who hold the secret. The introduction of improved armor will have far-searching effect, but it can hardly be hoped, in view of the mad race for huge dimensions, that better armor will lessen the displacement of ships designed to fight in our first line.—*United Service Gazette.*

A SUPERBLY CLOTHED BATTLESHIP.—In view of the discovery of a better process of hardening armor plates in this country, and the patent of which has been secured by the Admiralty, it is interesting to note that special attention is at the moment being paid to the protection of the sides and vitals of American warships of the latest design. Taking the armor plan of a battleship of the United States Navy which will shortly join the fighting line, we find that the *Utah* has a screen of armor which is probably one of the most complete and effective of any protection yet given to a warship the world over. There is, to begin with, a main belt of plates with an average thickness amidships of 11 inches, and which is over eight feet wide. Above this is a second belt eight feet wide, which has nine inches as an

average thickness. The water-line belt extends from stem to stern, and the upper belt runs from the wake of the aftermost to the wake of the foremost 12-inch turrets. The turrets of the primary guns have a protection ranging from twelve inches to eight inches of the latest armor; while the battery containing a portion of the secondary armament of 5-inch guns is protected by armor plates six and a half inches thick, and similar plates protect the 5-inch guns at the bow and stern. The *Utah* also has a splinter screen of two inches of armor between her 5-inch guns in their batteries, and a longitudinal wall of 3-inch armor which closes in each 5-inch gun. There is thus nine and a half inches of armor to penetrate before a projectile could reach the base of her smokestacks.—*United Service Gazette.*

NEW TYPE OF SIEGE ORDNANCE.—To destroy modern permanent fortifications it is necessary to use a heavy shell containing a large charge of high explosive. This is usually fired from a 7-inch or 8-inch howitzer weighing some 5 tons, with mounting, which requires a concrete platform taking a month to construct. Messrs. Krupp have recently brought out a siege howitzer weighing only 2 cwt. with bed, yet capable of firing a shell of 185 pounds. The shell is not loaded into the howitzer, but is placed on the muzzle and propelled by a rod which projects from the shell and passes down the bore. The howitzer itself presents no special points of interest; it is a muzzle-loader of 2.2-inch caliber mounted on a bed which can be transported on wheels. The novelty lies in the projectile, which is shown in the annexed illustration. This is a thin sphere of steel, 15 inches in diameter, filled with high explosive, and traversed by a central tube *a,* threaded in front to take the fuse *b,* and open in rear to take the propelling rod *c.* This is of hollow steel, with a shoulder abutting against the base of the shell. The front portion fits loosely in the central tube of the shell, and the rear portion is enlarged at *d* to fit the bore of the howitzer. The cast-iron cup *e* is a loose fit on the rod, and is recessed to fit over the muzzle of the howitzer. On discharge the whole projectile is propelled forward until the enlargement *d* meets the cup *e;* this checks the forward velocity of the rod, which drops out of the shell, leaving the latter to fly forward alone.



HOWITZER PROJECTILE

With a charge of 6 ounces smokeless powder the 185-pound shell carries 400 yards at 43° elevation. To reduce the range the howitzer is further elevated, the carriage permitting of elevation up to 80°. It is stated that very satisfactory accuracy is obtained, the mean lateral error at 400 yards being only 9.35 yards, and the mean error in range 4.72 yards. The muzzle velocity is 197 foot-seconds.—*The Engineer.*

AERIAL TORPEDOES.—The Unge torpedo, intended for the destruction of balloons, has acquired an increased importance since Messrs. Krupp have bought up the patent rights. The new projectile is an improved version of Hale's war rocket, once used in the British Army. Its special advantage for firing at balloons lies in the fact that its trajectory is clearly visible by night or by day, enabling the aim to be readily corrected. The inventor's efforts have been directed towards the improvement of the accuracy of the rocket, which used to be a very variable quantity. The rocket is fired from a light-rifled gun, which gives it an initial rotation; this is maintained by the powder gases, produced by the burning of the composition, which escape through helical channels. The latter are connected to a central reservoir, the effect of which is to equalize the pressure of the gases. A

tapering hole is made down the center of the composition, the diameter of which is so regulated that the composition near the base burns away first. The composition consists of different grades of powder inserted in successive layers, so that it burns faster as the rocket gathers speed, and as the air-pressure behind it is reduced. The head of the rocket is a high explosive shell, with a sensitive fuze designed to act on touching the envelope of a balloon. The whole torpedo weighs 40 pounds if made of the smallest size proposed, namely, 4 inches in diameter, and the gun from which it is fired weighs 140 pounds complete. A dirigible like the new German M III, can carry twelve of these torpedoes, with the gun, in addition to its crew, and this armament would render it a formidable antagonist to any other war balloon.—*Army and Navy Gazette.*

MISCELLANEOUS.

ADMIRALTY CRITICS.—A very remarkable paper has been read before the National Defence Association by Rear-Admiral Bacon, which is included in the current issue of *National Defence.* The paper was entitled "The Most Pressing Requirement of the Navy," and the danger upon which Admiral Bacon dwelt was irresponsible criticism of the Board of Admiralty and the effects of such critcism upon naval efficiency. "Do we really believe," he writes, "that any critics outside the Board of Admiralty can possibly have the same wide grasp of the requirements of the navy as that possessed by the departments at the Admiralty. . . . ." It might appear from this that Admiral Bacon sees danger in all criticism of the Board; but he adds, as though conscious of the futility of that attitude: "Let us have criticism by all means, but let the critic remember that, although he may want more battleships than the Admiralty consider necessary, the Board can still be honest, and even perhaps he himself may be wrong. . . . ." Or, similarly, if the critic desires more destroyers or cruisers, he is invited to remember that the Admiralty are not traitors should they happen to hold other views as to the uses to which such vessels should be put. Or, again, those critics who want a naval war staff, modelled on German and military lines, may still be invited to consider that such an organization may be radically unsound and unsuited to "the changes and chances of sea requirements." The pitfalls to which the outside critic is liable are many, but perhaps, as Admiralt Bacon contends, the deepest of all is his liability to take a narrow instead of a broad view of any given case. The point is well put and worth quoting:

"I could perfectly well advance to-night more than one indictment against the Admiralty. Without apparently departing from the truth, I could argue that the Admiralty has been guilty of indifference to the best interests of the service, and my statements might be difficult to explain away. But, knowing the whole truth of the case as I do, my statement would really be an untruth, and my argument wickedly false."

Every officer who has held high responsibility in any branch of the public service will recognize the broad truth of the above dictum. The expert in a position of responsibility must of necessity know far more than any outside critic, and be able—if a man of intelligence—to take the broader view. We are all agreed as to the peril of dragging the navy and its organization into the party arena, and doubtless the average Englishman does try to avoid that evil. But the danger of criticism does not end there, for, as Admiral Bacon writes: "The gratuitous assumption of incompetence, neglect and cowardice, and the attribution of personal motives conflicting with public duty—these are the evil insinuations which are at times scattered broadcast, and which tend to destroy confidence and shake discipline." The critic who aspires to be useful instead of mischievous must thus avoid the pitfall of fixing upon some isolated detail without regard to to its perspective in the picture of the navy as a whole. A distinguished admiral once expressed his astonishment to Admiral Bacon at the fact that most

officers who went to the Admiralty appeared to recant their previous convictions—even to relapse into unaccountable lethargy. This apparent tendency had also surprised Admiral Bacon until he served under the Board. He then discovered that the whole expanse of the navy had to be surveyed instead of isolated details . . . . "and matters which from immature knowledge appeared so simple and obvious were found to be far more doubtful and complex when viewed in the light of ascertained facts." It is here, of course, that irresponsible critics appear to take the Board at a disadvantage. Their knowledge is limited, their field of vision restricted; they do not perceive the complexities to which Admiral Bacon alludes. Thus, "the critic may call loudly for the fires of heaven to descend on the Board for building four large ships instead of five; but does it ever enter his head how impossible it is to show that sixty-five large ships and not sixty-four are a vital necessity to the safety of the empire." As to that example, it may be retorted that the Admiralty, in declining to ask for four big ships instead of five or six, are liable to be influenced by the parsimony of the Cabinet, whereas the critics and the press may possibly take the wider view. Admiral Bacon ignores the political pressure against which the Sea Lords have often had to contend. He ignores the adaption of building programs, manning requirements, etc., to political exigencies. So, it may happen that the critics can help the Board by calling public attention to this or that weakness in the provision for shipbuilding, manning or other matters.

As a result of excessive and irresponsible criticism, says Admiral Bacon, the country is mystified, and the opinion is formed by the public that our navy cannot safely fight unless it enjoys a two-to-one superiority, at least. No doubt many naval officers are thus influenced, but Admiral Bacon contends that the naval officer has only a right to demand that his force in action shall be equal to that of the enemy. The function of the Admiralty, we are told, is to ensure that these conditions of equality in action can be fulfilled—allowing a proper margin for unforeseen contingencies. Any strength beyond this, says Admiral Bacon, is a matter of national insurance which the country may insist upon if it so pleases. He tells us that Boards of Admiralty are generally very willing to build the surplus ships, and to maintain the surplus crews, when the country demands that form of insurance. On the other hand, it is unreasonable to expect any Board of Admiralty to press the Cabinet for such surpluses, and this form of unreasonableness is often displayed by the critics. Of this we had repeated examples during Lord Fisher's last three years at Whitehall, many of the critics crying aloud for his expulsion from office, simply because Sir John and his colleagues were satisfied with the margin of our relative strength, judged from the strictly professional standpoint. The mischievous effects of those organized attacks upon Lord Fisher are a matter of common knowledge. The Administration of the navy is still being carried on upon the same broad principles now that Sir A. K. Wilson has replaced Lord Fisher as chief adviser to the First Lord, and it is highly significant that the screams and lamentations of the critics have died away, although there is no change of policy.

In the discussion following the reading of the paper under consideration, Sir Gerard Noel agreed that "the one requirement of the navy was that it should be let alone, now that we had the right men at the Admiralty." He also deprecated the reduction policy of 1904, which alone, in his view, had rendered the present ruinous German competition possible. Sir Gerard Noel is a distinguished officer, and entitled to his opinions, but he certainly missed the whole point of Admiral Bacon's paper in saying that the navy could be let alone "now that we had the right men at the Admiralty." The real point of the paper we have endeavored to show is, that the country should at all times repose due confidence in the Board of Admiralty, and credit the members of the Board with a high sense of public duty and responsibility. "What matters this or that detail of education or any other reform compared with the mighty strength which belief in the admiralty

and the navy will inspire in the country in war-time? What matters one or two battleships, or any other craft, compared with discipline?" There is sound good sense here, although Admiral Bacon has underrated the value of really impartial criticism.—*Naval and Military Record.*

GETTING THE BEST RESULTS FROM MEN.—The Japanese have a saying, which, like many Japanese things, is doubtless of exceeding antiquity, that "to get the best results from men, overlook little faults in them."

Maxims such as this throw light on human nature, opening up a vast deal of matter well worth sober reflection. The complexities and the ever-differing phases it presents to us are bewildering. Most of our "big men" will unreservedly admit that their success is attributable in great measure to an understanding of their fellow-men, especially of those whose behavior they control to a greater or less extent.

When we engage the services of a "human machine," we always have certain duties laid out which the newcomer is expected to undertake, and we try to get the best man for the place. Having engaged him, we set him to work and anxiously watch results. Has he ordinary or exceptional intelligence? Is he energetic, careful, calm under trying circumstances? In short, has he the right sort of stuff in him? If not, we look elsewhere.

Now, when we purchase a machine tool and find it slightly unfitted for requirements, we can usually make a change in construction, which will correct the difficulty. We do not find it necessary to "overlook little faults" in it. Why? Because the machine tool is never supersensitive; it is never obstinate, perverse, discouraged.

If the human machine could be controlled by the set rules that govern machine-tool operation, the world would be a much different place. Now, we must have our expensive Government, our expensive business organizations. All because we can't tell this minute what half the people are going to do the next.

Of all costs, labor cost is usually greatest; moreover, the greater part of the running expenses of most businesses is the supervising expense. Good money is paid to some people to see that other people do their allotted tasks correctly. Consequently, the supervising expense should command gravest consideration when conducting a "greater efficiency" campaign, which brings us back again to the Japanese maxim.

There will be hardly a dissenting voice if we make the statement that "to get the best results from men, offer inducements commensurate with the cost to them of maximum effort."

To expect men to do their utmost by simply driving them machine-tool fashion, is contrary to human nature and pretty well understood to be so to-day. Admission of the fallacy of this driving method is not, however, sufficient to get the results all manufacturers want; the pendulum must swing to the other end of the arc—the force must be attraction instead of propulsion.

How, then, is the employer to do all this? How shall he plan and act that his employees will gladly, cheerfully exert themselves to the utmost for the enterprise in which their efforts are combined?

Whoever has witnessed an intercollegiate boat-race has noticed how at the finish the crew of one boat will collapse, while those in the other boat row on without one faltering stroke. Both crews may have done the same amount of work; nay, the winning crew may have done a shade more work than the losers; why, then, the marked difference in physical and mental condition? In business a great many of us row a race every day, and we know that our condition at the end of to-day's race has a great deal to do with our speed in to-morrow's race. Who, then, that employs men to "race" for him will deny that it is to his best interests to have his men feel that they have won at the end of each day's race?

There are many ways of accomplishing this, as many ways as there are different men and women. Some of them are well-known ways; others, though understood by our Columbuses, our Hannibals, our Napoleons,

remain enigmas to most of us still. Perhaps the best known and most frequently practiced means is the provision of inducements affecting the worker's finances or ambitions; an ever-present knowledge of sure reward or promotion does more to bring the result sought for than anything else to be named.

Next in power comes, perhaps, the comfortable sense of satisfaction felt by a workman in knowing that his employer is worthy of his respect and his best effort. Then, too, there is the intimately sympathetic and cheerfully enthusiastic employer who, because he is what he is and because he has made his workmen his friends, calls out from them unasked the daily sweat of their faces.

To the healthy human being it is good to work and to work hard, when his work is made pleasant for him and when he is paid at least the market value for his efforts. Otherwise he becomes the unwilling horse, the oarsman with a broken oar and even an enemy in the camp.—*Iron Age.*

THE SUBMARINE MENACE. IS THE BATTLESHIP DOOMED?—(*By Periscope.*)—Time is sometimes very rapid in working out its revenges. It is not many years since the British naval authorities were roundly abused by what has been described as the "historical school" for devoting so much money and attention to the creation of submarine flotillas. It was held that the submarine was the arm of the weaker power, desirous only of pursuing a purely defensive policy. On this assumption it was argued that Great Britain had no business to embark on the construction of submarines. During the recent agitation against Admiralty shipbuilding policy, the progress which has been made in the creation of submarine flotillas was persistently ignored in an effort to prove that Germany was making greater headway than this country in fleet expansion. The fact was, of course, that the Board of Admiralty, largely owing to Lord Fisher's influence, persisted in laying down a large number of submarines each year—to some extent at the expense of the destroyer program. To the amateur critic this procedure did not appeal. He pointed to the fact that Germany was building a large number of destroyers, and was devoting practically no attention to submarines, and, therefore, ipso facto, the British Admiralty must be wrong, because Germany, in the eyes of these critics, is always right. Even a considerable number of naval officers regarded the expenditure upon submarines as little better than waste of money.

Germany's attitude towards the submarine has undergone a dramatic change. This type of craft is no longer ignored on the other side of the North Sea, where submarines are being built rapidly. In the action which she is now taking Germany is following the lead of the British authorities, and it is no longer suggested that the submarine is the work of the weaker power, and possibly useful for purposes of coastal defence. Critics of Admiralty policy have suddenly swung round and recognize in the submarine an effective instrument for offensive purposes. They are already looking forward calmly, and with a certain gleam of satisfaction, to the day when Germany will possess large flotillas of submarines. Hardly a word of credit is given to the Board of Admiralty for its action in realizing the virtue of this new type of craft and pressing on with its construction year after year in the face of a large body of naval and public opinion. According to the Dilke Return, the present position in submarines built and building is as follows:

	Built.	Building.	Total.
Great Britain	63	11	74
Germany	8	..*	..*
France	56	23	79
Russia	30	3	33
Italy	7	..	7
United States	18	10	28
Japan	9	3	12

* Number uncertain.

As the result of foresight in appreciating the real virtues of the submarine, Great Britain leads the whole world in this type of construction. She is even ahead of France, for a large number of the craft included in the French total are admittedly ineffective, whereas only the earliest, more or less experimental, boats in the British service are otherwise than thoroughly warworthy. Whereas, built or building, Germany possesses probably twelve or fifteen submarines, Great Britain, including the ships about to be laid down, has upwards of eighty. This is not the only advantage which has accrued from the action of the Admiralty. In the British service a vast deal of experience has been gained in the employment of these craft, and no navy in the world possesses so large a body of officers and men skilled in all the niceties of submarine navigation.

In the current number of *Blackwood's Magazine* appears a most interesting article by Colonel a'Court Repington, C. M. G., on the menace of the submarine. This distinguished writer has suddenly become an exponent of Admiralty policy with reference to these craft in that he appreciates their value, and, indeed, goes considerably beyond the views held by the most enthusiastic pioneers of the British service who were faithful to the submarine at a time when it was regarded as little more than a toy. Like all converts, the writer has lost himself in his zeal. Colonel Repington not only believes in the future of the submarine, but he holds that it is the craft of almost exclusive importance in the present naval situation. He not only pins his faith to the submarine, but he believes that "the great ships to which we devote so much money every year—though they have been, are, and may for a few years more be necessary—will within a limited period of time become useless for most operations of which the North Sea and the Channel will be the theater." Colonel Repington, while refraining from criticism of the all-big-gun principle, sets out to show why "neither *Dreadnoughts*, pre-*Dreadnoughts* nor super-*Dreadnoughts* will a few years hence have any place in a naval war waged in such narrow waters as those of the North Sea."

The author of the *Blackwood* article has an exaggerated idea of the amount of money which is being invested in these ships, and speaks of the super-*Dreadnought* costing "from two to two and a half millions sterling." It is well to keep to sober facts. The latest British *Dreadnought* of which complete details are available is the battleship *Neptune*, and the Navy Estimates show that instead of costing two to two and a half millions sterling, the total outlay upon this vessel, including guns, is put at £1,728,449. So far no British battleship has been conceived which cost even two millions. Nor is Colonel Repington accurate in stating that a super-*Dreadnought* "carries a thousand men," and "can be sunk by a torpedo fired from an invisible submarine, costing perhaps £60,000 or £80,000, at 7000 yards range." Colonel Repington makes this statement as to the vulnerability of such a large ship without any attempt at proof, as though he were stating an axiom of general acceptance. The fact, however, is that it is impossible to say with absolute assurance what effect the explosion of a torpedo would have on vessels constructed as the British *Dreadnoughts* are. There is, however, a general opinion amongst naval constructors that while a torpedo might do serious injury to such a ship, it would not sink it.

This is one point that deserves to be noted. Another is that Colonel Repington in his enthusiasm for the submarine has omitted to attach due importance to the limitations inherent in these craft. The North Sea is not a small lake. It is spoken of as one of "the narrow seas" because in comparison with the large oceans its area is restricted; it is not, however, by any means a millpond. It contains, roughly, 150,000 square miles of water; it has a length of about 600 miles, and at one point from the Firth of Forth to Jutland its breadth is about 400 miles. Therefore, when Colonel Repington claims it as "falling within the category of narrow waters," it would be a mistake to regard the North Sea as something a little larger than a lake, to be readily dominated by a few submarine vessels.

On the other hand, no one can doubt that the writer has reached a correct conclusion regarding the submarine as an important offensive weapon which is likely to have a dramatic influence upon naval policy on the North Sea. This is apparently the reason which has led the Admiralty during the past few years to devote so large a proportion of the sum available for naval construction to the building of these craft.

Admitting that the submarine has come to stay, admitting that it is likely to prove an effective offensive arm and admitting that Germany may in the distant future possess a large number of these craft, are we necessarily driven to Colonel Repington's conclusion that "the North Sea in time of war will very soon be, if it is not now, no place for a sea-going ship." The writer draws an alarming picture of the possibilities of naval warfare in these waters.

"Swarms of destroyers and submarines, and every year more of the latter, will infest this sea, and the existence of every great ship venturing into the area controlled by these pests, which are almost unassailable by naval means, will be most precarious. Our great and costly battleships and cruisers must be stowed away safely in some distant, safe and secluded anchorage—Scapa Flow and Portsmouth to-day, Berehaven and Lough Swilly perhaps to-morrow. The North Sea in time of war will be a desert of waters, insecure on both sides, open to neither, commanded by none."

This is an alarming picture and it encourages Colonel Repington to hold the view that, "while we may make the North Sea a *mare clausum* in war, both to German sea-going fleets and to German merchant vessels," by stationing our main fleets at its two exits, we cannot hope to employ our battle fleets directly against Germany. In his opinion our battle fleets will have to keep out of harm's way, and leave the flotillas to carry on the war. Arguing on this basis, he arrives at the conclusion that it is possible that we may be able to give relative protection to the up-Channel trade bound for the port of London, but that even here Germany may succeed by harassing and attacking trade and diverting a portion of it to our southern and western English ports. Colonel Repington thus comes to the conclusion that along the rest of the east coast of England and Scotland trade by way of the sea will probably be almost suspended until the submarine menace is disposed of.

How far will experienced sailors agree with this writer's conclusions? On this hypothesis, will they admit that the day of the battleship is over, and that the money which is being devoted to the construction of such vessels is largely wasted? No one doubts that the submarine is destined to influence powerfully the future of naval war, particularly in narrow waters, but experienced naval officers will certainly hesitate to go anything like the whole length with Colonel Repington.

It is only at the tail of Colonel Repington's article that we get at the motive which apparently had a great deal to do with his enthusiasm for the submarine. He believes that the battle fleets holding the exits of the North Sea may succeed in strangling German trade, but he is not satisfied that this would be a satisfactory conclusion, because he is nervous as to the outcome of the "war of the flotillas." Colonel Repington adds that:

"If, for example, Germany discovers, or has discovered, the means for effectually attacking submarines, and if we have not, it is possible that Germany, when she has constructed the submarines upon which she seems resolutely bent, may dominate the North Sea by their means, and put us to the dilemma either of allowing her army of invasion to land, or of attacking it—may be a convoy of dummy transports—and of thus exposing our battle fleets to the blows of German submarines which we may have no certain means of destroying. It will not be altogether a satisfactory end to a war if we ruin, indeed, German seaborne trade, but end with the Pomeranian Grenadier in Palace Yard and the Altona Corps at Arthur's Seat."

This is surely the conception not of a practiced student of war, but rather of an alarmist who is anxious to prove the necessity for raising a conscript

army. Colonel Repington seems to have concluded that Germany holds all the cards in the struggle between the flotillas, whereas the exact contrary is the fact. There is no purpose in arguing on such a basis, and the only real solid facts that we have to do with to-day are these:

(1) Great Britain possesses a notable lead in submarines.

(2) Great Britain has a great superiority in other types of torpedo-craft.

(3) The submarine and destroyer, which are a menace to battleship and cruiser, are also no less a menace to German transports loaded up with German soldiers to whom the menace of the torpedo will appeal powerfully.

(4) Germany has not yet invented an anti-submarine.

On examination all Colonel Repington's fancies disappear, and we have the old naval truths left little affected. Naval supremacy can be maintained only by the big armored ship, supported by torpedo-craft of various descriptions. The various types will play rôles, but neither the one nor the other is going to drive either class off the seas.—*Naval and Military Record.*

SUBMARINES AS SEA-GOING VESSELS.—We do not hesitate to say that the most important fact, to-day, in the development of naval material is the surprisingly rapid improvement of the submarine. A few enthusiasts have been struggling with the seemingly unconquerable difficulties of submarine navigation with such success that at last they have produced an engine of warfare, in the presence of whose latest performances even the most conservative among us must ask whether the supremacy of the big battleship is not most seriously threatened.

The submarine of to-day is a very different craft from its progenitor of ten or a dozen years ago. Particularly is this true of the type which has been developed for the United States Navy, the latest representatives of which are sea-going vessels possessing fair speed, a wide radius of action and great certainty of control both at the surface, in making the dive, and when running submerged. Furthermore, thanks to the bold initiative of the builders, the latest navy submarines, built at the Fall River Works and represented by the *Salmon,* have demonstrated by her ocean voyage of 1500 miles to Bermuda and back, that the time is coming when the submarine will be able to accompany a battleship fleet upon the high seas.

In fitting the *Salmon* for this cruise, no special navigating bridge was provided. The vessel was navigated by Mr. G. C. Davidson, late lieutenant-commander of the United States Navy. The underwriters required that a convoy should be taken, and the *Salmon* was, therefore, accompanied by the tug *Underwriter,* which rendered no assistance whatever to the submarine on the run to Bermuda.

The *Salmon* is 134½ feet long by 15 feet in diameter. When running at the surface she displaces 230 tons and in the submerged condition her displacement is 345 tons. On her official surface speed trials she made 13¼ knots and she averaged 12¼ knots on her 24-hour surface trial at sea. In diving, she first sinks to the submerged condition by admitting water to her ballast tanks, and then, with a reserve buoyancy of 1250 pounds, a slight depression of the diving rudder causes the boat to dive with remarkable steadiness at an angle of inclination of from one to two and a half degrees, until the required depth of 15 feet is reached, when the whole hull is submerged and nothing but the slender tubes containing the periscopes is visible. The *Salmon* has effected a quick dive, from a full speed of 13¼ knots on the surface under oil engines, with ballast tanks empty, to submerged running with the electric motors at 9 knots in 3 minutes, 22 seconds.

At the beginning of the run to Bermuda the *Salmon* carried her normal gasoline supply of 6000 gallons, besides 385 gallons of lubricating oil, 1085 gallons of fresh water and 700 pounds of rations for twenty-one men for seven days. She got under way at Provincetown, Mass., at 9 p. m., on July 6, and proceeded to Hamilton, Bermuda, at a speed of 10 knots. On

the following day she ran into a strong southwest wind and rough sea, which lasted two days; and during this time she was navigated from the upper bridge, except from 1.30 p. m. until midnight on Friday, when she was navigated from inside the conning-tower. A defective cylinder-head gasket on the port engine necessitated running the craft from Thursday to Saturday under the starboard engine alone, at a speed of 7½ knots. Seasickness on the part of the green engineering force of landsmen necessitated delaying repairs until port was reached.

The distance run from Provincetown was 718 miles and the average speed maintained was 7.8 knots. The total distance of the trip from Quincy was 768 nautical miles; the consumption of gasoline was 3000 gallons, and of lubricating oil 95 gallons. While in Bermuda no repairs were made to the engine or other machinery, except the renewal of the gaskets in the cylinder heads.

The *Salmon* left Bermuda for Quincy, Mass., at 9.30 a. m. Wednesday, July 13, and reached Provincetown at 3.40 Saturday, the 16th. During the voyage back both engines functioned satisfactorily and an average speed of 9.7 knots was maintained. At 1 p. m., while off Cape Cod, the gasoline supply was exhausted and a tow was taken until 3.45 p. m., when the boat proceeded to Provincetown under her electrical motors. This tow was taken as a matter of convenience, since the storage batteries were fully charged and they are sufficient to drive the vessel 150 miles under the surface. On examination it was found that accidentally one-half of the gasoline supply had been blown overboard.

The total run of this record-breaking cruise (for no such voyage out into the Atlantic had ever been attempted before) was 1514 miles. The average speed for the whole cruise was 8.7 knots. The gasoline consumed shows a radius of 1536 miles under the adverse conditions of the outward trip, and a radius of about 1650 miles under the more favorable conditions of the return trip.

The habitability of the boat was thoroughly demonstrated. The ventilation of all parts of the boat, except the torpedo compartment, was satisfactory. The torpedo compartment has not, as in later boats, any means of supplying fresh air, and the ventilation, therefore, was poor, particularly in view of the fact, that the cooking was done in this compartment; an operation which in later boats is performed in the after battery compartment, which has perfect ventilation from the engines. While at sea the temperature of the air outside and in the body of the boat was about 80°. The engine-room temperature varied from 100 to 110°.

This Bermuda cruise disposes of the doubt that the submarine can ever be regarded as a sea-going craft. Hitherto it has been looked upon as a mere adjunct to the system of harbor defences; and its value has been set down as due mainly to its "moral effect." But to the naval man it is evident that an enlarged *Salmon* with its speed and radius greatly increased, will prove a formidable competitor of the battleship for the supremacy of the sea.—*Scientific American.*

AN OIL-MOTOR STEAMSHIP.—Controversy waxes warm in German shipping circles as to what extent the oil-fuel steamer constructed at the yard of Messrs. Blohm & Voss for the Hamburg-Amerika Company for the petroleum trade will fulfil the expectations formed of her. The two large motors to be employed are of the Diesel type, each generating 1500 horsepower, and one immediate advantage is the economy, amounting to 75 per cent, which will be effected in engine-room space, thus giving so much the more cargo accommodation. Another economy effected by the change is in the smallness of the engine-room staff, only three engineers and three oilers being required for both motors, in watches of eight hours each. For fuel, petroleum residues will be employed. In Germany it can be bought for £2 a ton, and in America, one of the terminals of the voyage, it is considerably cheaper. The whole cost is considered to be about 75 per cent

less than coal. The vessel's screws are somewhat smaller than those usually allotted to craft of 9000 tons, making about 150 revolutions a minute, but it is expected that a speed of about 12½ knots will be obtained. Whilst ordinary steamers can only convert about 16 per cent of the fuel consumed into energy, a motor-driven vessel converts 40 per cent. The new steamer, which will be completed in twelve or fourteen months, is intended for the Hamburg and New York and Philadelphia route.—*Page's Weekly.*

DOCK YARD MUSEUMS.—The first thing to engage the attention of King George when he landed to inspect the establishments at Portsmouth on his recent visit was the new dock yard museum. This is housed in the old fitting loft, which has proved to be well situated for the purpose, and the chief credit for the establishment and organization of the museum belongs to Mr. Frost, who for nearly eleven years has served as secretary to the Admiral-Superintendent at the Portsmouth yard. A similar museum was started at Chatham a few years ago, mainly on the initiative of Admiral Swinton Holland, and here among other objects of interest may be seen the quaint flag of the Commonwealth period, which for many years was preserved in an old chest in the Admiral-Superintendent's house. The idea of such museums as these at the naval ports is an excellent one, and deserves encouragement in every way. It is not surprising that King George spent some time inspecting the exhibits at the new museum at Portsmouth, for his interest in nautical antiquities generally, and the archæology of the British naval service in particular, is well known.—*Army and Navy Gazette.*

MARITIME ARCHÆOLOGY.—The preliminary meeting on June 14 of the supporters of the project for establishing a society for the study of nautical archæology was most encouraging. Of one hundred persons who had expressed their willingness to join such a society, quite half the number attended the meeting. Among those present were naval officers, officers of the mercantile marine and yachtsmen; writers on naval history, strategy, tactics and the art of sea warfare; archæology, chronology and technology; architecture, administration, commerce, hygiene and international law, with other nautical subjects; painters, book illustrators and other artists; the representatives of societies connected with seamen and seafaring and many other students of the sea and its story. Mr. W. L. Wyllie, who presided, said that, speaking for marine painters, he was sure that they would as a body support the society. Sir John Laughton referred to the great assistance it could render the historian, and Mr. Douglas Owen pointed out the valuable influence it might exert in the direction of the improvement of our naval museums. So far, apparently, the theatrical profession is unrepresented, and yet all interested in dramatic art may derive benefit from the advice of such a society, for the stage has been responsible for some of the most atrocious caricatures of seamen and sea life. We may hope yet to see an actor-manager in the chair at the society's meetings. Nor were there any writers on costume present, and from most of their works it would be impossible to learn that the English seaman has been recognizable by his attire for nearly 500 years, or that to be "disguised as a sailor" was a common stage direction in Tudor times. Mr. Carr Laughton is to be congratulated on the satisfactory prospects of his public-spirited efforts towards the organization of the study of maritime archæology. Now that the society is fairly set a-going there should a large influx of members, and those who wish for information on the subject should write to him at 5, Ruvigny Mansions, Putney, S. W.—*Army and Navy Gazette.*

PROFESSOR SPENSER WILKINSON'S THOUGHTS ON THE NAVY.—To a meeting at the Royal Colonial Institute, Professor Spenser Wilkinson revealed some of his "Thoughts on Imperial Defence." For the most part, he has been thinking about a war between Germany and this country, and he does not appear to have found much consolation. The new German Navy, he

feels, "is the creation of men whose familiarity with land warfare gave them a perfect grasp of the necessity for tactical superiority which they have been seeking by intelligent study and practice for twenty years." As a result, they have evolved, Professor Wilkinson says, the doctrine that there is no such thing as a strategical reserve. This means "that you should begin a war by employing for the first blow, as far as possible, the whole of the forces which you possess. Instead of letting one squadron after another engage with a part or the whole of the opponent's fleet, you should collect for the first battle every ship or every man you possess, in order as far as possible to overpower him at the very beginning." It seems to us that if Germany goes to work in this way it will simplify matters, and at least there can be no bolt from the blue, since before the German fleet can be mobilized the reserve must be called out, and if every ship is to be collected for the first battle, what becomes of the torpedo menace? It does not appear to have occurred to Professor Wilkinson that the familiarity with land warfare he speaks about may not be the inestimable advantage to sea commanders that he appears to think it is. So far as the British Navy is concerned, the professor is troubled by his belief in its neglect of tactical study and tactical practice. We feel sure that his belief is ill-founded; nor is it true, as he says, that "the officers in the navy who are regarded as its best tacticians are at least doubtful whether the type of battleship and armored cruiser upon which many millions are being spent is designed in accordance with sound tactical principle." Professor Wilkinson attempted to explain the conditions of success in naval war. The most important of them all, he said, was tactical superiority. He defined it this way:

"One navy or one army has tactical superiority over another when a given fraction of the one finds that it can fight better and can beat a corresponding fraction of the other."

This, he says, is the lesson of the whole history of war. We should like some further explanation of this definition. What is the corresponding fraction in one navy of any given fraction in another? Are these fractions to be understood in terms of classes of ships, or in terms of squadrons or divisions of fleets. Like Colonel Repington, Professor Wilkinson thinks that "the battleship has found a new enemy in the torpedo, and in the next war the fighting will not be confined to the surface of the sea, but will be carried on in the waters under the surface and in the air above it." But it has yet to be shown how the fractions in the air may exercise a tactical superiority when engaged with fractions on the surface or under the sea. You cannot have skill without practice, says Professor Wilkinson, and it only the skilled fighter, "the man whose knowledge of what to do with the implements of war is so thorough as to be almost instinctive, who is the proper judge of the implements which he requires, and of the value for a fight of the different kind of weapons." We agree, but it is only the Japanese who can be said to have recent knowledge of this description, and, so far as we are aware, there is no difference between the principles underlying their policy of shipbuilding and ours. We also agree with Professor Wilkinson that nothing is more important than that the Government should have a naval strategist to direct the movements of its fleets and to prepare the instructions for the admirals commanding them. The Professor would like, apparently, to appoint his own strategist, but we believe the navy would be quite content, should war come soon, to see its direction left to Lord Fisher and Sir Arthur Wilson. At no time in the history of navy has its strategical disposition or tactical training reached a higher standard than it has under the administration of these two officers.—*Army and Navy Gazette.*

BRITISH NAVAL MANEUVERS AND THEIR PURPOSE.—*An Historical Retrospect.*—1887.—An inferior fleet under Sir Edmund Fremantle evaded a superior fleet under Sir William Hewett and threatened the Thames.

1888.—An attempt to blockade a hostile power in his ports by two British fleets slightly superior in numbers failed. The fleets under Tryon and FitzRoy broke the blockade of Baird and Rowley, and the hostile cruisers raided the British coasts and commerce.

1889.—An attempt by a superior British fleet, assisted by localized squadrons, to mask the enemy's fleet failed. The enemy raided coasts and commerce, and was not brought to decisive action before the maneuvers ended.

1890.—A hostile fleet attempted to maintain itself upon an important trade route and interrupt traffic, avoiding a general engagement in face of a slightly superior British fleet. Owing to the faulty drafting of the instructions no definite result was obtained, but some useful experience was gained with torpedo-boats.

1891.—Two distinct sets of maneuvers were carried out by four separate squadrons. The operations of the two principal fleets were not strategical. The secondary maneuvers, which took place in the St. George Channel, were undertaken by two small squadrons opposed to one another, one supplied with torpedo-catchers and the other with torpedo-boats. Offensive action undertaken by a force of catchers was moderately successful.

1892.—An attempt by two divisions of a powerful fleet to effect a junction for the purpose of securing the command of the sea in a channel whose opposite sides were occupied by the two belligerents. The junction of the fleets was accomplished without much difficulty in spite of the efforts of the hostile fleet and its superiority in torpedo-craft.

1893.—The opposed fleets were subdivided, each consisting of two squadrons, the Red fleet being slightly stronger than the Blue, but one of the divisions of the Blue fleet was stronger than one of the Red. The Blue side was assisted by a flotilla of torpedo-boats. The Red commander attempted to drive his opponent out of disputed waters, but the result was indecisive.

1894.—Two fleets attempted to effect a junction in waters in which was a force superior to either of them, but inferior to them when combined. This force consisted in part of a small division at some distance, and a superiority of torpedo-vessels. The fleets, in attempting to make their junction, were beaten in detail. Destroyers were first introduced in these maneuvers, but the torpedo craft did little owing to the fact that only one night was sufficiently dark to give them an opportunity for attack.

1895.—Two fleets were to leave their respective ports on a certain day, and each to proceed to a rendezvous unknown to the other. From these positions they were to take the necessary measures by means of their scouts and cruisers for finding each other and effecting a junction. The junction took place within about 17 hours after the two fleets began their search. The torpedo flotilla operated independently for the purpose of testing the use and value of destroyers.

1896.—The problem concerned the possibility of a fleet leaving port without the knowledge of the look-out cruisers of a superior and masking fleet, and effecting a junction in another port at a distance with a friendly force. The fleets were, as previously subdivided, but the two portions of the blockaded fleet evaded the watching cruisers and effected a junction. They also evaded the enemy's fleet, which had united for the purpose of bringing on an action, and got safely into the port, where they were supposed to meet their friends.

1897.—The curve of search. The Channel and Reserve fleets were subdivided, and one division of each set to search for the other, but owing to a misconception of the instructions the operations were not altogether successful.

1899.—Wireless was used for the first time on this occasion. A British convoy of slow ships was ordered to wait at a certain rendezvous for the arrival of a protecting squadron. A hostile fleet put to sea to intercept and capture the convoy before it could be met by its protectors. In spite of the excellent arrangements made by the enemy for searching the area in which the convoy was placed, these failed, mainly owing to the fog, and the

convoy was taken safely into harbor by its protecting squadron. The success was said to have been at least in part due to the wireless installation in some of the cruisers, and by which means news was transmitted between two ships over a distance of 60 miles apart.

1900.—To obtain information relative to the working of a fleet composed of all classes and fighting for the command of the sea. The subdivisions of the fleets succeeded in uniting at a pre-arranged rendezvous, but the maneuvers ended indecisively, owing to neither having a well-marked superiority over the other.

In 1901 two fleets known as X and B, and commanded by Vice-Admiral A. K. Wilson and Rear-Admiral Sir Gerard Noel, fought for the command of the English Channel, the ultimate aim of X being to stop the trade and of B to cover it. The umpires decided that B fleet had been beaten.

1902.—No maneuvers took place in home waters, but after the Coronation Review the Channel and Cruiser squadrons proceeded to the Mediterranean. No representatives of the press were present, and guests were excluded from the ships engaged. A narrative of the exercises was issued afterwards. The special object of the scheme was to ascertain what risks were involved in keeping such a close watch on a fleet in a defended port as to ensure bringing it to action if it issued therefrom. The blockaders were not successful in their main object. They failed to prevent the escape of the blockaded fleet.

1903.—The whole of the Mediterranean, Home and Channel fleets took part in operations, together with the Cruiser squadron and 16 additional cruisers. Eight flag officers were present. A much larger area was assigned to the exercises than had been usual, and it was entirely in the Atlantic. The fleets engaged were known as X and B. Interest centered in a fleet action between the contending forces, and the verdict of the umpires was that the command of sea remained with X.

1904.—Naval maneuvers were carried out in August. Those in which the Channel and home fleets participated were secret, but the torpedo maneuvers in the Irish Channel were attended by newspaper correspondents. The object on the one side was to keep the sea secure between Land's End and the Mull of Galway. The other side had to attempt the destruction of this, but was unsuccessful, owing in the main to the large number of destroyers with which their opponents were provided, although before the operations ended most of these were destroyed.

1905.—Combined battle exercises were carried out by the Mediterranean and Atlantic fleets in May and in August, but they were not reported. The reserve divisions also engaged in maneuvers in July with squadrons selected from the Channel fleet, cruiser squadrons and destroyer flotillas, but no report was issued.

1906.—The general idea of the maneuvers was based upon the assumption of a war between a strong naval power, Red, and a weak naval power, Blue. Blue attempted an attack on the Red trade in order to cause the dispersion of the Red fleet. All the available ships of the navy took part, and the co-operation of the mercantile marine was invited. The press was represented. In the *Admiralty Remarks* issued on the conclusion of the operations, the umpires stated that the success of Blue was only achieved at the expense of the complete disorganization of his fighting forces, and that had hostilities continued "it is practically certain that the commencement of the third week of the war would have seen all commerce-destroying ships either captured or blockaded in their defended ports." It was also remarked that "the summary of Red and Blue losses will show the cost of a *guerre de course* against a superior naval power, and proves that though a temporary commercial crisis might possibly be caused in London by this form of attack, the complete defeat of the aggressor could not be long delayed, with the result that public confidence would be quickly re-established and the security of British trade assured."

Since 1906 the strategical exercises which have taken place have been conducted in secret, and no official reports have been made upon them. In 1907 there were no grand maneuvers, but divisional exercises took place in February and October, off Lagos and in the North Sea respectively. Only fully commissioned ships took part.

In 1908, in addition to similar divisional exercises, grand maneuvers took place in July under the direction of Lord Charles Beresford in the North Sea. The number of vessels engaged was 314. Two fleets, A and B, succeeded in effecting a junction in face of third fleet, C, stronger than either of them separately, but weaker than they when united.

In 1909, in addition to the divisional exercises, grand maneuvers took place in July off the west coasts of Ireland and Scotland, under the direction of Sir William May. The number of vessels engaged was 374. Two fleets, A and B, attempted to effect a junction in face of a third fleet separated into three parts, C, D and E. The strongest force was A, but C, D and E, when united, were stronger than A and B together. A and B succeeded in effecting a junction, but were at once brought to an action by the enemy in overwhelming force.—*Army and Navy Gazette.*

CONTRABAND OF WAR.—*"Absolute" and "Conditional."*—One of the most important decisions come to by the International Naval Conference was the determination of the specific items which will be held to constitute contraband of war. The decision arrived at was that the following articles may, without notice, be treated as contraband of war, under the name of absolute contraband:

1. Arms of all kinds, including arms for sporting purposes, and their distinctive component parts.
2. Projectiles, charges and cartridges of all knds, and their distinctive component parts.
3. Powder and explosives specially prepared for use in war.
4. Gun mountings, limber boxes, military wagons, field forges and their component parts.
5. Clothing and equipment of a distinctly military character.
6. All kinds of harness of a distinctly military character.
7. Saddle, draft and pack animals suitable for use in war.
8. Articles of camp equipment, and their distinctive component parts.
9. Armor plates.
10. Warships, including boats, and their distinctive component parts of such a nature that they can only be used on vessels of war.
11. Implements and apparatus designed exclusively for the manufacture of munitions of war, for the manufacture or repair of arms or war material for use on land or sea.

In addition to determining what should constitute absolute contraband, it was decided that the following articles, susceptible of use in war as well as for purpose of peace, may without notice, be treated as contraband of war, under the name of conditional contraband:

1. Foodstuffs.
2. Forage and grain, suitable for feeding animals.
3. Clothing, fabrics for clothing and boots and shoes, suitable for use in war.
4. Gold and silver in coin or bullion, paper money.
5. Vehicles of all kinds available for use in war, and their component parts.
6. Vessels, craft and boats of all kinds, floating docks, parts of docks and their component parts.
7. Railway material, both fixed and rolling stock and material for telegraphs, wireless telegraphs and telephones.
8. Balloons and flying machines and their distinctive parts, together with accessories and articles recognizable as intended for use in connection with balloons and flying machines.

9. Lubricants, fuel.
10. Powder and explosives not specially prepared for use in war.
11. Barbed wire and implements for fixing and cutting the same.
12. Horseshoes and shoeing materials.
13. Harness and saddlery.
14. Field glasses, telescopes, chronometers and all kinds of nautical instruments.

Under no circumstances will the following be considered contraband of war:

1. Raw cotton, wool, silk, jute, flax, hemp and other raw materials of the textile industries, and yarns of the same.
2. Oil seeds and nuts, copra.
3. Rubber, resins, gums and lacs, hops.
4. Raw hides and horns, bones and ivory.
5. Natural and artificial manures, including nitrates and phosphates for agricultural purposes.
6. Metallic ores.
7. Earths, clays, lime, chalk, stone, including marble, bricks, slates and tiles.
8. Chinaware and glass.
9. Paper and paper-making materials.
10. Soap, paint and colors, including articles, exclusively used in their manufacture, and varnish.
11. Bleaching powder, soda ash, caustic soda, salt cake, ammonia, sulphate of copper.
12. Agricultural, mining, textile and printing machinery.
13. Precious and semi-precious stones, pearls, mother of pearls and coral.
14. Clocks and watches, other than chronometers.
15. Fashion and fancy goods.
16. Feathers of all kinds, hairs and bristles.
17. Articles of household furniture and decorations, office furniture and requisites.

Likewise the following may not be treated as contraband of war:

1. Articles serving exclusively to aid the sick and wounded. They can, however, in case of urgent military necessity and subject to the payment of compensation, be requisitioned, if their destination is territory belonging to or occupied by the enemy or the armed forces of the enemy.
2. Articles intended for the use of the vessel in which they are found, as well as those intended for the use of her crew and passengers, during the voyage.

To sum up the situation as it has existed prior to the Declaration of Paris and the Declaration now under notice, it has been free for a belligerent power to make her own rules as to what she would consider contraband of war, to such an extent as she considered it safe to go, having in view the disposition of the neutral powers concerned. It was open to her to even interdict all supplies if she could pursue such a course with safety and had the means of enforcing it.

The conditions in regard to maritime capture have changed so completely during the century in which this country has been at peace since the French wars, the last naval warfare of any dimensions in which the British were engaged, that every possible consideration should be given to the views of those critics who fear that any further restrictions will invalidate or weaken the nation's naval superiority, on which she depends in the absence of being a first-class military power.

Prior to the Declaration of Paris in 1856, the British insisted on the right of capturing all enemy's private property at sea under neutral flags as well as under the enemy's flag. This procedure was plain, direct and simple, and, when the former right was foregone, some alarm was excited, as is now again occurring in connection with the recent conference detailing the conditions under which neutral trade shall in future be conducted, it

appearing to those who look at it from some points of view as a curtailment of the privileges of naval superiority.

It must, however, be remembered that the economic position of Great Britain has totally changed during the past century. Her inhabitants have unfortunately largely become aggregated in large towns and cities, where they rely on the import trade, for not only the materials for the industries in which they are engaged, but for their daily food. It by no means necessarily follows that the fleet will not be able to retain free passage of the seas for the nation's mercantile shipping and for the adequate supply of the materials and food they require, or that there will be any necessity to transfer national shipping to neutral flags to obviate capture or to ensure the safety of such cargoes, but the mere restriction of the rights of capture of supplies coming to a country so dependent on them should have a beneficent effect, and would in fact be a safeguard. The case presented, however, by the critics of the conference is that we need not consider such safeguards which restrict so greatly the power of our fleet to punish an enemy's trade and to bring her to her knees, as the fleet should be able to ensure the non-interruption of national supplies under our own flag, and that even in protracted operations the country is so situated that in a war, especially with a country like Germany, our western ports and extent of coastline are so extensive as to make a complete stoppage of sea-borne trade an impossibility, and a blockade of the whole coast out of the question.

To return to the details of what is considered contraband, "condition" contraband and non-contraband. It will be seen that the articles considered as absolute contraband are practically all munitions of war in regard to which there can hardly be any question. Any particular power reserves the right to add by declaration to the list of "absolute contraband," but only has the power to do so in regard to articles exclusively used for war. Such notification has to be addressed to the Governments of other powers or their representatives accredited to the power making the Declaration. There will now be an International Court of Appeal at The Hague, to which any neutral may appeal from a decision in the national courts, where such cases will be decided in conformity with the principles which have recently been arrived at. Undoubtedly a belligerent has the right of interfering with any assistance being rendered to the enemy, the damage to her interests being infinitely more than that to the neutral concerned. Hitherto the decision has resided in the national courts, the only redress for any injustice being for a nation seriously aggrieved to consider any glaring case an act of war.

Absolute contraband is liable to capture if it is shown to be destined to any territory belonging to, or occupied by, the enemy, or to the armed forces of the enemy. It it immaterial whether the carriage of the goods is direct or entails transshipment or a subsequent transport by land. Proof of the destination will be complete:

1. When the goods are documented for discharge in an enemy port or for delivery to the armed forces of the enemy.

2. When the vessel is to call at enemy ports only, or when she is to touch at an enemy port or meet the armed forces of the enemy before reaching the neutral port for which the goods in question are documented.

Where a vessel is carrying absolute contraband her papers will be conclusive proof as to the voyage on which she is engaged, unless she is found out of the course indicated by her papers and unable to give adequate reasons to justify such deviation.

The English, by right of naval predominance, have hitherto always held a policy of extending the making contraband of war or articles which might prove of the least assistance to the enemy, but this view has never been supported by Continental nations, and would be an extremely dangerous one to enforce to any marked degree in a modern war. Its day has undoubtedly gone under more modern conditions, however much it may be regretted.

When the items of conditional contraband are considered one comes to more debatable ground. The first item alone, viz., foodstuffs, provides an object on which volumes might be written. It must be remembered, however, that these items are "conditional" contraband only, that is to say, they are only contraband and liable to capture if they are shown to be destined for the use of the armed forces or of a Government department of the enemy State. It will, therefore, be seen that foodstuffs and many other important items may continue to come freely, for general, as distinct from military, use in neutral bottoms, irrespective of that carried, subject to capture, by our own ships, and also that raw materials for industries will not be considered contraband under any circumstances, thus providing against many miseries in the unfortunate event of the country being engaged in hostilities with any combination of powers.

To reiterate more clearly what has just been stated, conditional contraband is not liable to capture except when found on board a vessel bound for territory belonging to, or occupied by, the enemy, or for the armed forces of the enemy, and when it is not to be discharged at an intervening neutral port. The ship's papers will be conclusive proof both as to the voyage on which the vessel is engaged and as to the port of discharge of the goods, unless she is found clearly out of the course indicated by her papers, and unable to give adequate reasons to justify such deviation.

Hitherto there has been no such thing as a list of what articles cannot under any circumstances be treated as contraband, and it is satisfactory that it has been possible to institute one. The tendency of the recent changes is decidédly to confine the hostilities as far as possible to the armed forces of the belligerents, and to spare misery to the home populations of the countries engaged, but whether they will attain that object, and whether it is altogether a desirable course to take from a national point of view, or subjugating an enemy, must be left to deeper discussion.—*Naval and Military Record.*

BOOK NOTICE.

"Under the Red and Gold, Notes and Recollections of The Siege of Baler." By Captain Don Saturnino Martin Cerezo, Commanding the Detachment. Translated and Edited by F. L. Dodds, Major, U. S. Army. The Franklin Hudson Publishing Co., Kansas City, Mo. Full cloth, $1.25.

This is an account of the heroic defence of the little town of Baler during an eleven months' siege by Filipino insurgents; it was written by the only surviving Spanish officer, who commanded the detachment during the greater part of the siege.

The following letter from General Funston, U. S. Army, to the publishers of the translation should be a sufficient recommendation:

FT. LEAVENWORTH, KAS., July 6, 1909.

The Franklin Hudson Publishing Co., Kansas City, Mo.

GENTLEMEN.—I desire to acknowledge with thanks the receipt of a copy of Major Dodds' translation of Lieut. Cerezo's account of the Siege of Baler, which you were kind enough to send me.

This story was of especial interest to me for two reasons. I was at San Fernando, Pampanga, in July, 1899, when the thirty-two survivors of that heroic band of Spanish soldiers were passed through the American lines on their way to Manila, and seven months later established the first American garrison in Baler, and gazed with wonder and admiration on that little stone church, the scene of what was probably the most gallant defence of a position in authentic military history. For hundreds of yards on every side the earth was literally turned upside down with trenches, approaches and redoubts, some of the first being within forty yards of the church walls. As to the church itself, there was not on its sides or ends a spot the size of a man's hand that had not been struck by a bullet, nor a space a yard square that did not show the mark of a shell or solid shot. In this little room and within the ruined walls of the priest's residence adjoining, a little handful of heroes, less than fifty men at the start, with what at the ordinary rate of consumption would have been three months rations, held out for eleven terrible months against a force of Filipino insurgents which varied in strength from 200 to 800 men, with half a dozen pieces of artillery, one of them a modern field gun. During this time there was not a day's cessation of the storm of infantry and artillery fire. A Filipino officer, who participated in the siege, told me in 1901 that the Filipinos lost in killed and wounded during those eleven months six times as many men as the strength of the besieged force.

The clothing of the men of the detachment literally rotted off them, they made sorties to get grass and leaves to eat, but would listen to no terms of surrender. Finally, when Lieut. Cerezo, the sole survivor of the three

officers of the detachment, was convinced by copies of Madrid newspapers passed to him by the besiegers, that months before the sovereignty of Spain over the Philippine Islands had lapsed, he agreed, not to surrender, but to an evacuation of his post, and was allowed to keep his flag and records and march out with honors of war, and with the stipulation that he should be passed through the American lines to Manila. The Insurgents, to their credit, respected these terms and carried them out, and the brave little band returned to Spain to receive merited honors, having given their country one of the most glorious episodes in its history.

I wish that every officer and man in our army would read this book. One who would not be inspired to great deeds by this modest and simple tale of heroism and devotion to duty must, indeed, have the soul of a rabbit.

Very sincerely,

FREDERICK FUNSTON,

Brigadier-General, U. S. Army.

LIST OF PRIZE ESSAYS.

1879.

Naval Education. Prize Essay, 1879. By Lieut.-Com. A. D. Brown, U. S. N.

NAVAL EDUCATION. First Honorable Mention. By Lieut.-Com. C. F. Goodrich, U. S. N.

NAVAL EDUCATION. Second Honorable Mention. By Commander A. T. Mahan, U. S. N.

1880.

"The Naval Policy of the United States." Prize Essay, 1880. By Lieutenant Charles Belknap, U. S. N.

1881.

The Type of (I) Armored Vessel, (II) Cruiser best suited to the Present Needs of the United States. Prize Essay, 1881. By Lieutenant E. W. Very, U. S. N.

SECOND PRIZE ESSAY, 1881. By Lieutenant Seaton Schroeder, U. S. N.

1882.

Our Merchant Marine: The Causes of its Decline and the Means to be taken for its Revival. "Nil clarius aquis." Prize Essay, 1882. By Lieutenant J. D. J. Kelley, U. S. N.

"MAIS IL FAUT CULTIVER NOTRE JARDIN." Honorable Mention. By Master C. G. Calkins, U. S. N.

"SPERO MELIORA." Honorable Mention. By Lieut.-Com. F. F. Chadwick, U. S. N.

"CAUSA LATET: VIS EST NOTISSIMA." Honorable Mention. By Lieutenant R. Wainwright, U. S. N.

1883.

How may the Sphere of Usefulness of Naval Officers be extended in Time of Peace with Advantage to the Country and the Naval Service? "Pour encourager les Autres." Prize Essay, 1883. By Lieutenant Carlos G. Calkins, U. S. N.

"SEMPER PARATUS." First Honorable Mention. By Commander N. H. Farquhar, U. S. N.

"CULIBET IN ARTE SUA CREDENDUM EST." Second Honorable Mention. By Captain A. P. Cooke, U. S. N.

1884.

The Reconstruction and Increase of the Navy. Prize Essay, 1884. By Ensign W. I. Chambers, U. S. N.

1885.

Inducements for Retaining Trained Seamen in the Navy, and Best System of Rewards for Long and Faithful Service. Prize Essay, 1885. By Commander N. H. Farquhar, U. S. N.

1886.

What Changes in Organization and Drill are Necessary to Sail and Fight Effectively Our Warships of Latest Type? "Scire quod nescias." Prize Essay, 1886. By Lieutenant Carlos G. Calkins, U. S. N.

THE RESULT OF ALL NAVAL ADMINISTRATION AND EFFORTS FINDS ITS EXPRESSION IN GOOD ORGANIZATION AND THOROUGH DRILL ON BOARD OF SUITABLE SHIPS. Honorable Mention. By Ensign W. L. Rodgers, U. S. N.

1887.

The Naval Brigade: its Organization, Equipment and Tactics. "In hoc signo vinces." Prize Essay, 1887. By Lieutenant C. T. Hutchins.

1888.

Torpedoes. Prize Essay, 1888. By Lieut.-Com. W. W. Reisinger, U. S. N.

1891.

The Enlistment, Training and Organization of Crews for our Ships of War. Prize Essay, 1891. By Ensign A. P. Niblack, U. S. N.

DISPOSITION AND EMPLOYMENT OF THE FLEET: SHIP AND SQUADRON DRILL. Honorable Mention, 1891. By Lieutenant R. C. Smith, U. S. N.

1892.

Torpedo-boats: their Organization and Conduct. Prize Essay, 1892. By Wm. Laird Clowes.

1894.

The U.S.S. Vesuvius, with Special Reference to her Pneumatic Battery. Prize Essay, 1894. By Lieut.-Com. Seaton Schroeder, U. S. N.

NAVAL REFORM. Honorable Mention, 1894. By Passed Assistant Engineer F. M. Bennett, U. S. N.

1895.

Tactical Problems in Naval Warfare. Prize Essay, 1895. By Lieut.-Com. Richard Wainwright, U. S. N.

A SUMMARY OF THE SITUATION AND OUTLOOK IN EUROPE. An Introduction to the Study of Coming War. Honorable Mention, 1895. By Richmond Pearson Hobson, Assistant Naval Constructor, U. S. N.

SUGGESTIONS FOR INCREASING THE EFFICIENCY OF OUR NEW SHIPS. Honorable Mention, 1895. By Naval Constructor Wm. J. Baxter, U. S. N.

THE BATTLE OF THE YALU. Honorable Mention, 1895. By Ensign Frank Marble, U. S. N.

1896.

The Tactics of Ships in the Line of Battle. Prize Essay, 1896. By Lieutenant A. P. Niblack, U. S. N.

THE ORGANIZATION, TRAINING AND DISCIPLINE OF THE NAVY PERSONNEL AS VIEWED FROM THE SHIP. Honorable Mention, 1896. By Lieutenant Wm. F. Fullam, U. S. N.

NAVAL APPRENTICES, INDUCEMENTS, ENLISTING AND TRAINING. The Seaman Branch of the Navy. Honorable Mention, 1896. By Ensign Ryland D. Tisdale, U. S. N.

THE COMPOSITION OF THE FLEET. Honorable Mention, 1896. By Lieutenant John M. Ellicott, U. S. N.

1897.

Torpedo-boat Policy. Prize Essay, 1897. By Lieutenant R. C. Smith, U. S. N.

A Proposed Uniform Course of Instruction for the Naval Militia. Honorable Mention, 1897. By H. G. Dohrman, Associate Member, U. S. N. I.

Torpedoes in Exercise and Battle. Honorable Mention, 1897. By Lieutenant J. M. Ellicott, U. S. N.

1898.

Esprit de Corps: A Tract for the Times. Prize Essay, 1898. By Captain Caspar Frederick Goodrich, U. S. N.

Our Naval Power. Honorable Mention, 1898. By Lieut.-Com. Richard Wainwright, U. S. N.

Target Practice and the Training of Gun Captains. Honorable Mention, 1898. By Ensign R. H. Jackson, U. S. N.

1900.

Torpedo Craft: Types and Employment. Prize Essay, 1900. By Lieutenant R. H. Jackson, U. S. N.

The Automobile Torpedo and its Uses. Honorable Mention, 1900. By Lieutenant L. H. Chandler, U. S. N.

1901.

Naval Administration and Organization. Prize Essay, 1901. By Lieutenant John Hood, U. S. N.

1903.

Gunnery in Our Navy. The Causes of its Inferiority and Their Remedies. Prize Essay, 1903. By Professor Philip R. Alger, U. S. N.

A Naval Training Policy and System. Honorable Mention, 1903. By Lieutenant James H. Reid, U. S. N.

Systematic Training of the Enlisted Personnel of the Navy. Honorable Mention, 1903. By Lieutenant C. L. Hussey, U. S. N.

Our Torpedo-Boat Flotilla. The Training Needed to Insure its Efficiency. Honorable Mention, 1903. By Lieutenant E. L. Beach, U. S. N.

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The Fleet and Its Personnel. Prize Essay, 1904. By Lieutenant S. P. Fullinwider, U. S. N.

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1910.

The Merchant Marine and the Navy. Prize Essay, 1910. By Naval Constructor T. G. Roberts, U. S. N.

The Naval Strategy of the Russo-Japanese War. Honorable Mention, 1910. By Lieutenant Lyman A. Cotten, U. S. N.

NOTICE.

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It now enters upon its thirty-seventh year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

ARTICLE VII.

Sec. 1. The Institute shall consist of regular, life, honorary, and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio,* an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life-members, given by proxy or presence, shall be cast, a majority electing.

Sec. 5. Associate members shall be elected from Officers of the Army, Revenue Cutter Service, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: "Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing."

The Proceedings are published quarterly, and may be obtained by non-members upon application to the Secretary and Treasurer at Annapolis, Md. Inventors of articles connected with the naval profession will be afforded an opportunity of exhibiting and explaining their inventions. A description of such inventions as may be deemed by the Board of Control of use to the service will be published in the Proceedings.

Single copies of the Proceedings, $1.00. Back numbers and complete sets can be obtained by applying to the Secretary and Treasurer, Annapolis, Md.

Annual subscriptions for non-members, $3.50. Annual dues for members and associate members, $3.00. Life members fee, $30.00.

All letters should be addressed U. S. Naval Institute, Annapolis, Md., and all checks, drafts, and money orders should be made payable to the same.

SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1911.

A prize of two hundred dollars, with a gold medal, and a life-membership in the Institute, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1911. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Board.

3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.

4. If, in the opinion of the Board of Control, the best essay presented is not of sufficient merit to be awarded the prize, it may receive "Honorable Mention" or such other distinction as the Board may decide.

5. In case one or more essays receive "Honorable Mention," the writer of the first of them in order of merit will receive seventy-five dollars and a life-membership in the Institute.

6. Any essay not having received honorable mention may be published also, at the discretion of the Board of Control, but only with the consent of the author.

7. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

8. All essays submitted must be either typewritten or copied in a clear and legible hand.

9. In the event of the prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of the gold medal.

By direction of the Board of Control.

PHILIP R. ALGER,
Professor, U. S. N., Secretary and Treasurer.